The Foundry Trade Journal

AND

PATTERN-MAKER.

THE OFFICIAL ORGAN OF THE BRITISH FOUNDRYMEN'S ASSOCIATION.

Vol. 9. JUNE, 1907. No. 66.

—PUBLISHED—
THE FIRST WEEK IN EACH MONTH BY

EAGLAND & Co., Ltd.,
165, STRAND, LONDON, W.C.

Devoted to the interests and advancement of the Iron, Steel and Brass Foundry Trades.

Subscription Terms: 7s. 6d. per annum, post free.

To place the "Journal" within the reach of Working Moulders and Pattern-makers the Proprietors will accept subscriptions, not less than three in number from one shop, at the reduced rate of 5/- per annum, such order to be countersigned by the superintendent or foreman of the shop as a guarantee of good faith.

Any Subscriber having difficulty in obtaining copies promptly should notify the Publisher of the "Foundry Trade Journal," 165, Strand, London, W.C., giving the name of his local newsagent.

WE INVITE PRACTICAL ARTICLES ON THE TRADE IN ALL ITS BRANCHES, WHICH WILL BE PAID FOR. MSS. SHOULD BE WRITTEN ON ONE SIDE OF THE PAPER ONLY.

All communications to be addressed to the Editor, or to the Publisher, as the case may be, of

THE FOUNDRY TRADE JOURNAL,
165, Strand, London, W.C.

BRITISH FOUNDRYMEN'S ASSOCIATION.
LIST OF SECRETARIES.

General Secretary: F. W. Finch, Kingston House, Lansdown Road, Gloucester.
Manchester: C. Carson Bransby, 113, School Road, Stretford
Birmingham: C Heggie, 76, Hillaries Road, Erdington, near Birmingham.
Cardiff: H Griffiths, Messrs. J. Williams & Sons, Ltd., Globe Foundry, Cardiff.

BRITISH FOUNDRYMEN'S ASSOCIATION.

The next annual Convention of the Association will be held at Sheffield on Tuesday, Wednesday, and Thursday, August 6, 7, and 8, 1907. The voting to decide the place of meeting was as follows:—Sheffield 98, Newcastle 49, and Halifax 30. The Council hope there will be a good muster of members present. Particulars as to place of meeting, and papers to be read, will be sent direct to the members as soon as ready.

F. W. FINCH,
Hon. Secretary.

—o—

CARBIDE OF SILICON: ITS USE AND VALUE IN THE STEEL FOUNDRY.

The average analysis of carbide of silicon is as follows:—

Silicon	62.0
Carbon	35.0
Iron	1.5
Aluminium	1.5
	100.0

The iron and aluminium are not present in the metallic form, but like the silicon in combination with carbon as carbides. Of the total 35 per cent. carbon, about 28 per cent. is in combination, and 7 per cent. in the form of free carbon.

Although formed at a temperature of not less than 6,500 degrees F., and insoluble in any acids, carbide of silicon dissolves readily in iron at the temperature of the blast furnace or open-hearth, and its high percentage of silicon early suggested it to metallurgists as a source of this element for the prevention of blow-holes and the production of sound castings.

The cause of the quieting action of silicon on violently foaming or boiling steel is two-fold, and, while authorities

may differ as to the relative importance of each action in the final result of a sound casting, there is general agreement that both actions occur.

The first is its action as a reducing or deoxidising agent. Such blow-holes as are caused by carbon monoxide and carbon dioxide (and with these the open-hearth process has principally to contend) are the result of a reaction between carbon and oxygen, the latter being either uncombined and in solution, or combined with the iron as an oxide (probably the protoxide, FeO). On adding silicon either in the form of ferro-silicon, silico-ferromanganese or carbide of silicon, the silicon displaces the carbon preferentially in the above reaction, and a solid body (SiO_2) is formed instead of gas. This readily unites with the ferrous and manganous oxides, forming a slag which rises and floats on the molten steel. This action, however, deals only with that portion of the silicon which is consumed and does not appear in the final analysis.

The second action depends for its accomplishment on that portion of the silicon which combines with or dissolves in the steel, and results from its well-known property of enormously raising the solvent power of steel for its occluded or contained gases. These may be carbon monoxide, carbon dioxide, hydrogen, oxygen, or nitrogen, though the three latter are of major importance in the Bessemer process.

The above results are obtained when silicon is added either in the form of ferro-silicon, silico-ferromanganese, or carbide of silicon, but in the latter case, however, with the addition of valuable and unique effects, best understood after relating its practical manipulation in the open-hearth process.

Carbide of silicon is a ladle addition instead of a furnace addition. The bath before tapping has been brought down, we will say, to a silicon content of 0.02 and carbon 0.10. The proper quantity of carbide of silicon in the form of powder and not previously heated is dumped into the empty ladle, and the contents of the furnace tapped upon it. During this operation considerable reaction and commotion seem to occur, which, however, cease about as soon as the ladle is filled, and the steel is ready to be drawn into the moulds at once.

The superiority of carbide of silicon to ferro-silicon as a means of raising the solvent power of the metal for its occluded gases is evident. The mere presence of silicon in any proportion does not assure that the metal will be quiet in the ladle and solid in the mould, but rather the fact that it has been added just previous to casting. Increasing silicon raises the saturation point, but it does not make supersaturation impossible by any later operation tending to introduce or liberate more gas. Even ferro-silicon containing 15 per cent. silicon may be porous after casting. A steel may be high in silicon and still be supercharged with gases and evolve them copiously on teeming, but a further addition raises its capacity for holding its gases and gives a tranquil metal. This being true, and in order that the final content of silicon may not be excessive, the addition of the same should be as late in the operation as possible, after all opportunity for reaction is past. With ferro-silicon the agitation of the metal and the entrainment of air due to tapping into the ladle might cause reaction and release of gases which the silicon previously added to the furnace would not control. Carbide of silicon, being a final ladle addition, precludes the possibility of any subsequent supersaturation of the metal from the generation or absorption of more gas.

The most valuable property of carbide of silicon, however, is its power of enormously raising the temperature and consequently the fluidity of the metal in the ladle. This is due to the fact that carbide of silicon is an endothermic compound—that is, on dissociation it gives off heat. When carbon and silicon combine to form a carbide at the extreme temperature of 6,500 degrees F., a point only attainable by the electric furnace, they store up as latent heat an enormous amount of energy. Its value has never been accurately determined, but from the closest approximations it has been possible to make it is found to greatly exceed the value of the heat that may be derived from the oxidation of the contained silicon.

The calorific value of silicon in the reaction we are considering is much higher than that of either aluminium or manganese. The heat available from the combustion of one gramme of these elements to their oxides is respectively :—

	Calories.
Silicon to SiO_2	7.8
Aluminium to Al_2O_3	7.2
Manganese to MnO	1.7

When to the calorific value of the oxidised silicon we add the, as yet, undetermined but undoubtedly large amount of energy available from the destruction

of the carbide of silicon (an endothermic compound) we have advantages over aluminium and ferro-silicon which preclude any comparison on the basis of increase in fluidity and temperature. When dissociation of the carbide takes place in the ladle, the stored latent heat energy is made available, and easily accounts for the remarkable rise in temperature not noted with ferro-silicon, where we have the oxidisation of the silicon only. This has been aptly illustrated in the difficulty some users have had with the ladle stoppers. Formerly, little care had to be exercised in having the sleeves fit closely to keep the hot metal from coming in contact with the stopper rod. When the use of carbide of silicon began, there arose at once the problem of keeping the now extremely fluid and superheated metal from entering the joints and melting off the rod; it was, however, a small practical detail easily overcome.

Some manufacturers are not using carbide of silicon as the sole source of silicon, preferring to add to the bath an amount of ferro-silicon giving the desired silicon content and then tap into the ladle in which has been placed a smaller quantity of the carbide. This gives a certain increase in fluidity, and effectively stops any boiling or scattering of the metal.

The following is the analysis of an average heat, where the whole recarburisation of the bath is accomplished in the ladle by carbide of silicon.

Product—Acid Open-Hearth Castings.

	C.	Si.
Bath contained	.09	.02
Added in carbide of silicon ...	.32	.55
Total	.41	.57
Present after recarburisation	.21	.25
Removed as CO and SiO_2 ...	.20	.32
Oxygen corresponding	.27	.36

It will be noted in the analysis of the carbide of silicon given above, that it contains no phosphorus or sulphur. This is a matter of prime importance in many processes where the percentages of these elements are already at the maximum allowable limit, and it is necessary to have the recarbonising material free from these impurities.

Messrs. J. W. Jackman & Company send us the above notes on the use of carbide of silicon in steel foundries

—o—

Messrs. J. D. John & H. John, engineers, Cardiff, have dissolved partnership.

THE GREY IRON FOUNDRY AS A BUSINESS VENTURE.*

By Thos. D. West.

Our secretary, in requesting this paper, stated that he desired the writer to describe what a man embarking in the grey iron foundry business should know before he begins; what methods to pursue after he has decided to start, and what obstacles he is likely to encounter. Each sentence forms the text for a paper in itself, but taking the first, the main point which should be considered in starting a foundry, we have the following:—

First: The great lack of good skilled labour.

Second: Influences retarding the training of a plentiful supply of skilled mechanics.

Third: Independence and insubordination of many of the few skilled and respectable men available that may be obtained after extra inducements are made for their services.

Fourth: Difficulties and losses arising from trying to do work with the riff-raff that a starter is compelled to employ in beginning operations.

Fifth: The slow attainment of discipline and organisation in a shop's working force.

Sixth: Losses through defects developed in machinery and tools caused by trying them out and bringing them into good working order.

Seventh: The advantage that sellers of appliances and purchasers of castings take of ignorant beginners.

Eighth: Extra risks with consequent losses by accidents incurred through the want of experience in operating machinery and shop appliances.

Ninth: Difficulties in obtaining practical and good executive managers and foremen.

Tenth: Losses and embarrassment caused by the narrow range of vision of hired managers, as compared with that of the man who may have his all at stake striving for a foothold.

Eleventh: Inability of proprietors, inexperienced in actual moulding, mixing and melting, to avoid mistakes in getting the best managers and foremen, the windy blow-hard being often better liked than the one of true merit because of inability to rightly judge.

Twelfth: The underestimation of the

* Paper read before the American Foundrymen's Association.

obstacles and uncertainties that every beginner must encounter.

The twelve points just given are, as a whole, encountered much more in brisk than in dull times, and in times of very great prosperity can be the means of driving the most experienced workers and financial managers to the wall.

A beginner's fight to exist can be such, even with sufficient working capital, that he is brought to the point to despair of success by reason of the great odds and seemingly insurmountable difficulties that will confront him.

The difficulty of obtaining good overseers, as well as skilled labour, which is most pronounced in good times, is alone one of the twelve factors that demands more consideration than a reasonable working capital, and often knocks out the best of experience, good management, and hard work.

We could take up every one of the twelve points and fill a number of pages with a discussion on them, but will let it go with the simple statement. Aside from the great need of skill, the general public's great lack of comprehension as to the demands on skill and experience needed by our moulders in connection with the making of castings is about the next greatest evil to injure many starters and the trade in general. This poor conception that the general public has of the foundry business has caused many novices to undertake the work, and there is one instance that recently came to the writer's notice in which a bookkeeper who never lifted a rammer put all his hard-earned money into a small foundry, and hired a farm hand to run it for him while he maintained his salaried position. This new foundry owner was a bright and modern financier, and when his working capital was exhausted he did not close his shop until he had involved others in his downfall.

There is one feature difficult to comprehend, and that is the great difficulty of making men inexperienced in the business realise its hazard as well as the fact that skill is required to make good castings. Of course, almost any fairly intelligent man can make a good casting, of almost any character, allowing him time to experiment, and where there is sufficient capital and cupola capacity to keep remelting his bad castings. Few beginners, however, have sufficient assets to support this experimental work.

The novice's inability to understand the requirements for making good castings at the first pouring is such that even men who can successfully make small and medium castings day in and day out believe they are competent to be trusted with the making of most any heavy castings. When this belief can be found so prevalent, as it is with moulders throughout the world, is it any wonder that many who have walked through a foundry a few times get the idea that all is easy, and that nothing else is required than a few patterns and sufficient muscle to pound sand, under the control of an intelligent business head, to make a foundry pay, ever forgetting that intelligence is one requisite, and experience another.

The question of the methods a man should pursue who has decided to start a foundry is answered as follows :—

First : He should make a thorough investigation to discover if there is a demand for the class of castings he intends to make, and what competition exists.

Second : The selection of a site that will be central to his market, and in building to start on as small a scale as practical, but planned for extensions that can be carried out without tearing down too much of the existing plant.

Third : In the search for machinery and appliances he should endeavour, as far as possible, to get the experience of others. The A. F. A. convention should be visited for its information, and its exhibits inspected to note and investigate the latest improvements.

Fourth : In buying machinery and appliances he should avoid, as far as possible, the purchase of second-hand tools. The new has all its life, whereas the old is more or less worn out, and will not, as a rule, give good service for the money expended.

Fifth : One seeking orders, and not competent to quote prices, should not be ashamed to seek his manager's or foreman's advice.

Sixth : In starting to make castings don't be in a hurry to fill your shop with work. Go slow, feel your way, and your chances of error or failure will be greatly decreased.

Seventh : Be sure to have sufficient working capital and good chances of obtaining a surplus over and above what is considered necessary.

As to what a man should know before he begins is rather a broad question to ask an experienced founder, with the expectation of getting any answer other than that he learn to be a thorough

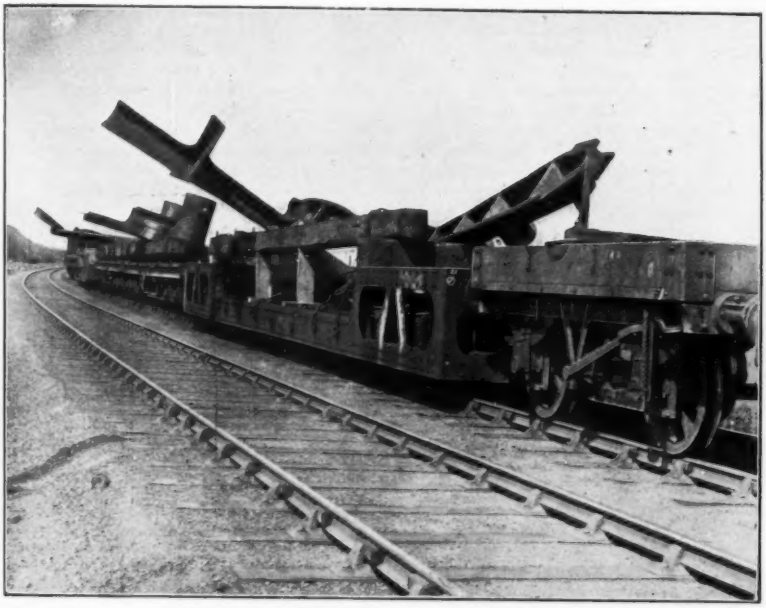
moulder as well as a business manager. No man who intends to be at the head of a foundry can be too thorough in the actual work of moulding, mixing and melting, and he should have executive and business qualifications.

There is no trade demanding so much skill and experience wherein so many enter who are wholly deficient in practical knowledge of its operations as the foundry business. It is a case of the many trying to make two wrongs make one right, and because some learn of an inexperienced man having made a success of his entry into the field they think they can do likewise.

Thirty year ago, few, if any, ever thought of going into the foundry business if they were not so practical that they could discharge any moulder and take hold of his work in a more masterly manner. To-day we find bankers, lawyers, and even clerical men who have assumed the management of foundries. We must ever remember that brains and intelligence do not stand for experience. If the day ever comes when practical education is given greater recognition, we will have the best that is possible in the foundry president or manager, as well as in the employé, but not before.

LARGE STEEL CASTINGS.

In the accompanying photograph we illustrate an interesting load of castings which was recently transported from Darlington to Middlesbrough. The consignment comprised a large stern frame, bracket, rudder and rudder post for one of the vessels now building at Nagasaki, for the Japanese Navy; and also a stern frame and bracket to the order of Messrs. Harland & Wolff, of Belfast, all of which articles had been manufactured by the Darlington Forge Company, Limited. Owing to the somewhat exceptional dimensions of the articles, it was only possible to transport the load on a Sunday by requisitioning two sets of metals and limiting the speed of the train to a maximum of fifteen miles per hour.



LARGE STEEL CASTINGS.

The stern frame was loaded on one of the North-Eastern Railway Company's 30-ton trolley wagons, and it had a total length, measured from the base line of the keel to the top of the stern post, of 38 ft. The keel piece was 19 ft. long. The overhang from the wagon side was no less than 9 ft. 6 in., and the extreme end of the post was 13 ft. 4 in. from rail

level. The bracket, loaded upon a 40-ton quintuple bolster wagon, measured 17 ft. between the centre of the shaft bosses, 21 ft. overall, and had a height of 15 ft. 2 in., the approximate weight being about 15 tons. In this instance the overhang from the wagon side was 7 ft. The rudder and rudder post were loaded upon ordinary 15-ton agricultural wagons, and the rudder, which was of the ordinary built-up type, had a 12 in. stock. The stern frame for Messrs. Harland & Wolff had a length exceeding 40 ft., and the keel a length of 20 ft., the approximate weight being 15 tons. The bracket measured 17 ft. 7 in. from centre to centre of shaft bosses and slightly over 20 ft. overall. The stern frames were each cast in one piece, and in both instances the brackets were of the "spectacle" type.

The special train left Darlington shortly after 9.30 on the morning of Sunday, the 5th ult., and the shipping point was safely reached shortly before noon, the articles for Japan leaving Middlesbrough a few days ago per s.s. "Glenlochy," for Nagasaki. The load for Belfast was detached from the Japanese load at Eaglescliffe Junction, from which point it was specially worked forward to Messrs. Furness, Withy & Company's yard at West Hartlepool, and subsequently shipped to Belfast.

——o——

USE OF A HEATED FOUNDRY MIXER.*

By J. B. Nau.

In many places, where foundries are located convenient to blast furnaces, the idea of using direct metal from the furnaces, thereby eliminating all intermediate remelting processes with their attendant increased cost and defects in quality, has been carried out and is practised to-day. The practice is naturally limited, at least in this country, to rough castings and cheap shapes, where the chemical composition and uniformity of metal are of less importance. In the finer grades of castings, where more exacting requirements are the rule, the use of direct metal from the blast furnace is excluded, and in many cases, as in cast-iron pipes, for instance, the remelting of the metal in a cupola or an air furnace is prescribed by specifications.

One of the greatest objections to the use of direct metal is naturally its lack of uniformity, which is not always possible to obtain even in the most carefully managed blast furnace. Could this uniformity of metal be guaranteed at all times, there is no reason why direct metal from the blast furnace should not find a more general application. Surely nothing could be more economical. It was mainly to overcome this difficulty that at the meeting of the Foundrymen's Association, held in New York in June, 1905, the writer recommended the use of a heated mixer as a kind of intermediary receptacle between the blast furnace and the foundry, into which the iron from the blast furnace could be poured. Kept liquid for any desired length of time, its quality corrected by suitable additions of either liquid or solid pig-iron or even wrought-iron scrap and from which it could be tapped in such quantities, and at such times as would suit the needs of the foundry.

To-day I am in a position to state that the first step in this direction has been taken by our foundry and that other foundries also contemplate the adoption of a mixer.

Last year, the writer received instruction from the general manager of a blast-furnace plant to design a mixer for the new foundry that the company is now building in that place, the name of which, for the moment, we are not at liberty to give. The foundry, which will be a most modern one in every respect in the beginning, will have a capacity of only 25 to 30 tons of very small castings, but ultimately, and in a very near future, its daily capacity is to be increased to fully 100 tons.

As stated, one of the features of the foundry will be the heated mixer to which the liquid metal from the blast furnace will be delivered.

Owing to the limited output, a high-priced tilting mixer with all its attendant operating and maintenance cost was out of the question. It was, on the contrary, decided to build a stationary furnace of the Siemens type, with a short and deep hearth and air regenerators of a capacity considered sufficiently large for the temperature desired in the mixer. To avoid the operation of gas producers and the building of gas flues and valves, oil was adopted as fuel. The rated capacity of the mixer is only 25 tons, or about sufficiently large to receive at one time all the iron that the foundry will require

* Paper read before the American Foundrymen's Association.

in a day's work in the beginning. On account of the very large number of small castings to be made the mixer will have to be tapped and stopped many times during the day.

If only one single tap hole were laid in the lowest part of the hearth, the danger of metal breaking through between two taps would be great. In order to avoid this it was decided to adopt a certain number of tap holes laid at different levels and to draw from the upper tap hole all the metal that can be taken there before opening any tap hole lower down.

A mixer of a 25-ton capacity is, however, large enough to supply a foundry of 100-tons capacity, and even more, the principle *role* of the mixer being to receive the direct metal from the furnace in large quantities during the day and while keeping it hot there and correcting its quality if necessary by suitable additions, withdraw it in repeated and smaller taps whenever required in the foundry.

The iron is brought from the furnace to the mixer in a ladle hung from an overhead trolley, thereby avoiding any interference with the yard track.

In large foundries, where different grades of iron are used for different castings, the mixer again will be handy. In this case the direct iron from the blast furnace could be stored away in a primary mixer of larger capacity from which it could be tapped to feed two or three secondary mixers of smaller capacities. Each of these could supply one department of the foundry and with suitable additions of either pig or wrought-iron scrap, the grade of iron required in that special department could be obtained accurately and with ease.

The mixer now building will not be in operation for some time. We can, therefore, submit no working data.

——o——

An International Exhibition of Hygiene, Arts, Handicrafts, and Manufactures, will be held in the Crystal Palace, Madrid, in September-November next, particulars of which can be obtained from Mr. A. Donderis, Spanish Art Exhibition, Compton House, 99A, Charing Cross Road, London, W.C. The various sections include reproductions in bronze, cast-iron, and foundry work, driven metal (materials, procedure, and products), etc.

CORRESPONDENCE.

BRITISH FOUNDRYMEN'S ASSOCIATION.

To the Editor of the Foundry Trade Journal.

Sir,—In your May edition I was pleased to notice a letter from "A. L.," Paisley, N.B., *re* the formation of a Branch of the British Foundrymen's Association, to meet monthly in Glasgow. I would like to know if "A. L." is a member of our Association; if he is I should be much obliged if he would place himself in direct communication with me. I found at the commencement of the Association, letter after letter appeared in the Foundry Trade Journal, with no direct result until a meeting was called of those interested to discuss the advisability of starting such an Association.

If he will do as I suggest we could consider the best means for opening a Branch in Glasgow. I may say that there is a very good prospect, as we have at present some 16 members in the district, and no doubt "A. L." would be able to give me some more names.

When the Manchester, Birmingham, and Cardiff Branches were formed, a meeting of members and others in those districts who interested themselves in it was called, and officers were appointed. This could be done in the Glasgow district if "A. L." will kindly give me his assistance. If necessary, I will attend and give the required information.

During the past winter our Branches have been doing splendid work with much usefulness to those connected with the foundry trade.

At all our Branch meetings I can assure "A. L." that there are no signs of caste, for every one connected with the trade is welcome. The Council accept as members, viz., employers, managers, foremen, and workmen.

It is certainly no unknown thing to find intelligent moulders who are neither a manager or foreman, and if "A. L." is not a member, the Council will be pleased to enrol him as one, and I sincerely hope he will give me his assistance in forming a Branch in the Glasgow district.

Yours truly,

F. W. Finch,

Hon. Secretary.

CASTINGS TO STAND INTENSE HEAT.

To the Editor of the FOUNDRY TRADE JOURNAL.

SIR,—We are making a large number of cast iron castings which have to stand an intense fire heat, but hitherto we have not been able to get good results. We have tried several mixings of iron, but find that when the castings are subjected to the heat they invariably break, and the cost of renewals makes the price practically prohibitive.

Will you kindly inform me what you consider to be the best way of making these castings, and what you think will be the best mixing to make them from.

Yours, etc.,
E. G. W.

WHITE METAL MIXTURE.

To the Editor of the FOUNDRY TRADE JOURNAL.

SIR,—I should feel obliged if any of your readers could supply me with information as to a good mixture for making plumbers' taps in white metal. I have had a great deal of trouble with the mixture I am using owing to blown holes in the metal due to what appears to be shrinkage.

Yours, etc.,
JAMES BROWN, JNR.
Glynn Works, Perth, N.B.

SAND FOR RADIATOR TUBE CORES.

To the Editor of the FOUNDRY TRADE JOURNAL.

SIR,—I shall be glad if any of your readers can give me a suitable mixture of sand to make radiator tube cores without core irons. Is it possible to make the cores without core irons without drying them in the core box? I have tried linseed oil, but find the cores always break on leaving the core box. Any information will be gladly received.

Yours, etc.,
"RADIATOR."

—o—

THE business of Messrs. L. S. Laurie & Company, engineers, New Street, Birmingham, has been acquired by Messrs. Hill & Hall, engineers, of Wolverhampton Road, Walsall.

THE STEEL FOUNDRY AS A BUSINESS VENTURE.*

BY W. M. CARR.

IN recent years the steel-casting industry has made rapid strides, and for many purposes cast steel is gradually and permanently superseding cast iron. The situation is recognised by all engineers as one requiring the attention of leading and progressive cast-iron founders. That the steel foundry business is an established industry is incontrovertible and one constantly improving and developing. The pioneers had their failures and losses, but ultimate successes are obtainable, so that prospective investors in steel foundries will not have thorny paths to travel, in order to get financial returns, as in the early days of the industry. The capitalist has better assurance of dividends than at any time in the past.

Capital.

The first question is, how much capital should be invested for a given output? The answer cannot be particularised, because local conditions affect each individual problem, but the following remarks covering the subject broadly will serve as a guide to prospective investors.

Large tonnages, of course, yield large returns, but the net profit on a given amount of capital does not vary directly with the size of the plant. Small plants can show as great a percentage of profit as larger ones. The demand will largely control the size of a plant. To illustrate we will consider a plant yielding 150 tons daily, or 4,000 tons monthly. Such a plant would employ about 1,800 hands, would require a large amount of ground with good shipping and receiving facilities. There should be at least five 25-ton open-hearth furnaces with four of them in regular operation. The furnaces would have to be served with electric charging machines, the moulding and casting floors served by several 35-ton cranes. Hoists and light travellers would be required in cleaning, finishing, and shipping departments. It should have a well-equipped power-house with engines and generators, pattern-shop, machine-shop, yard locomotives, and liberal moulding machine installations. Such a plant as described could not well be started without $1,000,000 capital, and the cost of erection of substantial buildings with crane

* Paper read before the American Foundrymen's Association.

runways and complete equipment would amount to at least $750,000. The following estimate on the basis of ton capacity will cover plants varying from 80 tons per day with a two 25-ton furnace plant to one with five 25-ton furnaces, producing 150 tons daily :—

	Dols.
Furnaces only	1,200
Gas producers, gas mains or oil tanks and accessories	600
Buildings, 800 square feet per ton at 1.25 dols.	1,000
Power, machinery, cranes, hoists, ladles, drying ovens, etc.	2,200
Total cost per ton	5,100

Such an equipment with a good demand for casting can show 25 per cent. on the investment.

General Practice.

In general practice it is better to have two open-hearth furnaces if a modest plant is desired. Keep one in reserve in case the active one should go out of commission. The larger furnaces, 25-ton capacity, are best suited for heavy castings, although some plants run successfully on pieces averaging 30 lbs. each. A shop should be designed with a view to the character of work to be produced. If small work, pieces averaging 10 lbs., a small open-hearth furnace is suitable.

Light Castings.

For very light castings weighing ounces, the Tropenas process is in use, but it will not reach the development promised by the open-hearth process producing basic steel castings. The pronounced limitations are the heavy losses and the high price of new material. It is admitted by the inventor of the Tropenas process that the loss in melting is 17 per cent., a loss which in comparison with any open-hearth process is wasteful. In open-hearth practice the loss in melting only averages 7 per cent., and under favourable conditions a much smaller loss can be shown. The pig-iron for the Tropenas process is said to be of a special composition and is scarcely used for any other purpose. The pig-iron for the basic process is cheap, domestic and plentiful in comparison, and further permits the use of almost any kind of steel scrap; the latter material for a Tropenas vessel must be like the pig-iron of special composition. The converter process is a comparatively new one and but very few operators can be found who are skilled. Investors who may place their money in Tropenas plants may find greater difficulties in their way than did the early users of the open-hearth processes, before commercial results can be obtained. The Tropenas process, however, is well suited for special purposes when certain kinds of steel are wanted in small quantities, but for general uses its own weaknesses are detrimental, preventing competition with open-hearth methods.

Basic or Acid Furnaces.

The question may arise as to whether an open-hearth plant should be fitted with basic or acid furnaces. The basic process is cheaper in the first place and the stock for it is more plentiful than for the acid. The chemical analyses of melting basic stock are wide and liberal. Those for the acid narrow and limited. The scrap for the basic process is almost only confined by its shape rather than its chemical composition. The scrap for the acid process is produced in the first instance by a basic process and will be represented by bloom ends, billet croppings, axle butts, plate clippings, etc., and is sold on analysis. It is stated that low phosphorus ores are getting scarce, while high phosphorus ores are quite plentiful, so in regard to the material from which pig-iron is made the basic process has the greater promise. Physically basic steel in castings is just as reliable in every respect as acid steel.

Department to Grey Iron Foundries.

To the grey ironfounder who feels the inroads of steel castings in his business and recognises the demand, but is not disposed to invest a million dollars in a 150-ton plant, I would like to suggest to him the erection in his shop of an open-hearth furnace anywhere from two to ten tons in capacity. The furnace to be lined with a basic bottom and designed to burn either natural gas or fuel oil. Take as an average size one of 5-tons capacity. Such would fit in ideally with existing equipment. Being basic, there would be no need of buying any fancy priced pig-iron; any pig-iron with silicon below 1.25 per cent., sulphur not over 0.08 per cent., and phosphorus with 1.00 per cent. or less can be used, and such analyses would cover some grades of cast iron scrap in the shape of old car wheels, malleable, etc., and charged with 50 per cent. of steel scrap such as springs, rails, agricultural scrap, defective steel castings, etc., would give an opportunity to produce steel castings of good quality from low grade stock. Being of a

moderate tonnage there would not be any heavy powered machinery to handle the heats. The only important change would be in regard to moulding sand, a special grade being necessary. The basic furnace could be used to put to profit machine shop turnings and borings by mixing them in moderate quantities with the charges.

In some cases it might be advisable to line the furnace for acid melting, and if desired it could be used for turning out "air-furnace-iron" heats.

Cost of a Small Furnace.

A 5-ton furnace, basic lined, erected in an active iron foundry, would cost about $6,000, and allowing $4,000 for special bottom, pouring ladles, oil storage tanks, burners etc., the total would be $10,000 exclusive of buildings. It would be capable of producing three heats daily, and would yield 12¾ tons of castings at the rate of 15 per cent. in melting loss, gates, heads, skulls, and defective castings, an average yield in a well ordered plant. Producing such tonnage steadily it should show good profits. The single furnace, however, has the disadvantage of going out of commission for repairs. It should turn out 400 heats before a general overhauling, or, say, a run of 133 working days. Assuming that the furnace was only productive nine months of a year at 25 working days per month, there would then be 225 days yielding a total output of 2,868¾ tons of product. Allowing an average profit of one-half cent. per pound there would be a gross profit of $28,687.50 annually.

But losses will arise in spite of best intention, and not to make the venture look too roseate the set-backs will be considered which might be caused by breakdowns, strikes, or errors on practice. These conditions might reduce the good castings to one-half of the metal charged so that 7¼ tons were the output. With the same productive period of 225 days per year, and with a decided shrinkage, because of losses, between manufacturing costs and selling prices, so that the gross profit was only one-eighth cent. per pound, the tonnage per year would be 1,687½ tons, and the returns therefrom $4,218.75. Out of this 25 per cent. can be deducted for interest on the investment, depreciation, etc., there would remain a net profit of $3,164.07, which is equivalent to 31.6 per cent. on the original $10,000.

The estimate in this case is very conservative, and the low yield is an extreme. With careful practice the results can be made better than shown. There will be pitfalls and irregularities, but they will be greater in a large plant because greater units are concerned and heavier risks. The small furnace will be profitable as well as the large one, and should times be lean, and the demand fall off, the small plant can bear the brunt as well as the bigger one because of the smaller amount of capital involved. There would not be in the small plant a top heavy organisation to maintain or the demand for dividends to be met.

Profitable Investment.

A steel foundry in prosperous times is a good earner, but because it is a steel foundry with great possibilities, like any industry it is not devoid of conditions of a negative character. An open-hearth plant with basic furnaces or acid furnaces does not have to pay patent royalties. The former type of furnace can take impure stock and refine it to steel. In that respect it has flexibility and a promising future. The acid process requires special composition stock of a limited nature in the market. The converter process requires skilled operators hard to find; has heavy melting losses, requires high priced stock differing somewhat from open-hearth acid stock in composition. The crucible process does not refine, but simply remelts the product of the basic process in the shape of waste material. There are other evidences in favour of the basic open-hearth process as meeting the needs of a growing industry, and the foregoing points mentioned are to be taken into consideration when looking into the question of engaging in the manufacture of steel castings.

——o——

In connection with the enquiry proposed to be made by the Board of Trade with the object of obtaining statistics as to the rates of wages and hours of labour prevailing in the United Kingdom, the circulation of the three enquiry forms has now been carried out. The first form asks for information as to the aggregate wages of workpeople for one week in each month, with the total number to whom wages were paid in such weeks; the second, giving a detailed analysis of wages paid in the last pay-week in September; and in the third, certain additional particulars as to hours and working conditions, more particularly on night shifts and piecework.

BRITISH FOUNDRYMEN'S ASSOCIATION.

The Birmingham Branch.

A MEETING of the Birmingham Branch of the British Foundrymen's Association was held at the Technical School, Suffolk Street, Birmingham, on Saturday, May 11, presided over by Mr. R. Buchanan, the President of the Branch. Mr. F. J. Cook, the ex-Secretary of the Branch, and a well-known foundryman, read to a large attendance of members a paper on the "Tensile Testing of Cast Iron."

The lecturer dealt mainly with practical aspects of testing, and gave details of the test required by prominent large companies, showing how results might be materially affected by the process of cooling, which, in some cases, where the process was rapid, resulted in a chilled white iron practically impossible to cut under ordinary commercial conditions. A series of figures were exhibited, showing that hard iron gave poor results for small castings, increased strength for larger, and weak for very large, whilst the soft iron gave strong small castings, with decreasing strength as the size increased. The speaker contended that the usual methods adopted by engineers to prove the tensile strength are not effective, and that it is practically impossible to compare figures for cast iron quoted in scientific papers, unless all the information as to size of bar, and mode of making same is fully stated. The American method adopted in accordance with the recommendation of a special committee of the Foundrymen's Association had the merit of definiteness. Bars should be carefully prepared, ensuring that all the machine parts of the test bar are parallel, and the curve at the neck made as flat as possible. A description was given also of a single lever testing machine complying with the Board of Trade requirements made by Messrs. W. & T. Avery, for testing up to 100 tons.

The paper was illustrated by limelight views, and has already been printed in the FOUNDRY TRADE JOURNAL.

A discussion followed.

MR. G. HAILSTONE thought the paper excellent, and emphasised the value of the wedge employed as showing the effect of cooling cast iron, and explaining why a certain description of iron was only good for certain sized castings.

MR. FOSTER welcomed the lecturer's commendation of the American system. For several years he had considered the 3 in. by 2 in. by 1 in. test bar a ridiculous bar, with which it was impossible to get anything like a good test. The American bar was 1¼ in. by 1 in., by 12 in. long, and that came nearer the ideal bar than any he knew. The present method of British testing showed altogether different values.

MR. PARKER said his own experience was in favour of casting separate tests, and getting more uniform temperatures. Certain tests he had made himself gave 15 tons to 16 tons breaking load, and in another case the test bar gave 22 tons per square inch on the tensile strength. That iron was quite grey, and could be machined with great ease. A case had recently been reported of a casting being forged like ordinary iron. With regard to phosphorus, it was a very useful element, but the proportion for the general run of castings should be 1 per cent. He did not like to see it going beyond that.

MR. MASON suggested whether the large amount of sulphur might not cause segregations, and pointed out that in a previous paper Mr. Longmuir reported that he had done best with a moderate casting temperature, whereas Mr. Cook succeeded with the highest possible temperature. He thought it would be very instructive to pay a visit to the works of Messrs. Belliss & Morcom.

MR. HEGGI considered that 1.8 of phosphorus, as a maximum, was too high, They ought not to go beyond 1.5, and he knew one firm, having an excessive number of breakages, attributed this to the proportion of phosphorus, which was 1.6.

The CHAIRMAN quoted Mr. J. E. Stead, as having suggested a series of tests, commencing with a long bar 6 ft. in length, the tests to be reduced a foot at a time, which would give them the different structures and strengths. Mr. Cook's tests seemed to prove that the present specifications for test bars did not indicate the character of the castings. He had himself found that the test bar often did not tell the whole truth, and a few years ago he wrote an article, entitled "The False Witness of the Test Bar." No man could say when it was telling the truth. (Laughter.) There was a widespread opinion among inspectors that foundrymen had certain knowing ways of getting a test bar to indicate a better metal than the casting itself. He hoped there was no ground for that suspicion; but if people resorting to

devious ways would exercise as much ingenuity in improving the quality legitimately, they would give greater satisfaction to the people who employed them. But, of course, all foundrymen were honourable men. It was clear that light castings, relatively to their area, were stronger than heavier ones, and Lord Armstrong, years ago, reduced hydraulic cylinders from 10 in. to 2½ in. thick, because the thinner ones worked more satisfactorily. In a thick cylinder there was an outer and an inner area, which was porous. With regard to Mr. Cook's experiments, it was a remarkable achievement to get 67 per cent. of the specimen breaking at between 13 and 17 tons tensile.

Mr. Cook briefly replied. He found 1.2 of silicon the best proportion for a 1½ in. casting. The ridiculous test bar described by Mr. Foster had been discarded in up-to-date foundries. The tensile test was important if engineers would go about it in the right way. Answering two or three questions, Mr. Cook remarked that with too much sulphur they were likely to get a lot of trouble, but he still believed they would have a much better wearing cylinder where they had a high temperature to deal with, as for example, when using superheated steam. He had always found that bad wearing cylinders were low in sulphur and high in manganese. With regard to Mr. Longmuir's tests, those were obtained in a specially prepared furnace at Sheffield University, and his medium temperature was about the highest they got under ordinary working conditions in cupolas.

A vote of thanks was accorded the lecturer.

The lecture was repeated on Tuesday, May 14, at a meeting of the Birmingham Metallurgical Society, and a discussion followed.

——o——

The English and Scotch Light Iron Castings Associations, which for some months have been working in unison in the matter of prices, have issued joint circulars intimating the withdrawa' of all selling prices, pending the issue of revised advance lists.

A casting, weighing 13 tons, was recently made at the Globe Foundry, Cardiff, of one of Brown, Lennox & Company's patent clump mooring anchors, for the new Cunarders. The metal was run off cupolas in the ordinary way into two large ladles, which were handled by 15-ton overhead electric gantries.

BRITAIN'S IRON FOUNDRY TRADE.

One of the greatest branches of the iron industry, in all countries alike, is that which produces iron castings. No attempt has ever been made to collect statistics of this branch in Great Britain That it is a large and important trade need hardly be said, although it is possibly less so since steel castings have come so much into use. The only basis of computation of the extent of the British foundry trade is far from satisfactory; it is that of attempting to compute the quantity of pig-iron available for its use after satisfying the requirements of other manufactures of secondary products.

Dealing thus with the production, imports, and exports of Great Britain, for the year 1906, we get the following results :—

	Tons.
Production of pig-iron	10,149,388
Iron taken from stock	117,000
„ imported as pig	89,246
Total	10,355,634

Consumption of Pig-Iron, or its Equivalent.

	Tons.	
In steel industry ...	6,500,000	
„ finished iron industry	1,075,000	
Exported as pig iron ...	1,664,442	
		9,239,442
Left for foundry use		1,116,192

This latter figure is subject to some modification by the volume of scrap iron and steel imported into Great Britain. The total imports under this head were 35,983 tons in 1906, and it is to be presumed that this tonnage was used up in British forges, etc., in lieu of pig-iron during the year to which the above figures relate. There should also be taken into account the considerable quantities of scrap of domestic origin similarly used.

It is estimated that the foundry industry of Germany employed in 1905 2,433,910 tons of pig, and produced 2,202,611 tons of foundry products. In order to reach this figure, Great Britain would have had to employ nearly a million tons more of pig-iron than the remainder shown above. It is hardly probable that the scrap employed to replace pig-iron in British works exceeded one-half of this quantity. In other words, the German foundry industry is likely to have produced a much larger tonnage of foundry products than that of Great Britain.

THE AMERICAN FOUNDRYMEN'S CONVENTION.

The Convention of the American Foundrymen's Association, was held in Philadelphia on May 21, 22, and 23. The opening session was held on Tuesday morning, and the Mayor of Philadelphia made an address of welcome. The reports of the President, Secretary, and Treasurer of the Association, and of various committees were submitted. The afternoon session was devoted to papers.

On Wednesday morning, the Brass Founders' Association which has been projected for some months was organised, and the afternoon was given up to papers accompanied by lantern slides. A smoker was given by the Philadelphia Foundrymen's Association in the evening. The greater part of Thursday was taken up with a river trip and a dinner, and visits were made to the Cramp shipyards and to other points of interest. The list of papers was as follows:—

"The Carnegie Technical School Foundry," by Director Hammerschlag, Pittsburg, Pa.

"The Training in Foundry Work at Pratt Institute," by Professor W. C. Stimpson, Brooklyn, N.Y.

"Industrial Foundry Education," by Herbert E. Field, Pittsburg, Pa.

"Some Facts Concerning Trade Schools," by W. E. McCarter, Marietta, Ga.

"Twenty Years' Improvement in the Brass Foundry," an address by Chas. J. Caley, New Britain, Conn.

"The Use of Heated Mixers in the Foundry," by J. B. Nau, New York City.

"Comparative Cupola Practice," by W. S. McQuillan, South Norwalk, Conn.

"Cost Accounts," by H. F. J. Porter, New York.

"Copper in Cast Iron," by W. M. Saunders, Providence, R.I.

"Sound, Clean Castings," by David Spence, Franklin, Mass.

"The Layout and Construction of Foundry Buildings," by Geo. K. Hooper, New York.

"Industrial Betterment," an address by H. F. J. Porter, New York.

"Some Points in the Coreroom which are not Considered," by Geo. H. Wadsworth, Cuyahoga Falls, Ohio.

"Foundry Design and Construction," by F. A. Coleman, Cleveland, Ohio.

"The Gray Iron Foundry as a Business Venture," by Thos. D. West, Sharpsville, Pa.

"The Steel Foundry as a Business Venture," by W. M. Carr, New York.

"The Malleable Foundry as a Business Venture," by R. Moldenke, Watchung, N.J.

"The Evolution of the Foundry Business," by Edward B. Gilmour, Elizabethtown, Pa.

"Modern Blast Furnace Practice," an address by President Edgar S. Cook, Warwick Iron and Steel Company, Pottstown, Pa.

"Cast Thread Fittings," by Henry B. Cutter, Seneca Falls, N.Y.

"The Supply of Skilled Labour for the Development of our American Industries," an address by Vice-President M. W. Alexander, American Society for Industrial Education, Lynn, Mass.

"The Universal System of Moulding Machines," by E. Ronceray, Paris, France.

"A New Method of Preparing Moulding Sand," by E. Ronceray, Paris, France.

"Shop Kinks, Short Cuts and Don'ts," by the Cleveland Pattern Foremen's Association.

"Manganese in Cast Iron," by Herbert E. Field, Pittsburg, Pa.

"A Few Denatured Brass Foundry Notes," by W. H. Parry, Brooklyn, N.Y.

"Uniform Cost Accounts for Jobbing Foundries," as recommended to the Jobbing Founders' Association by the Cost Committee of that Association.

"Dry Galvanising," by Alfred Sang, Pittsburg, Pa.

"Cupola Linings," by A. F. Spencer, Pittsburg, Pa.

"Standard Methods for Analysis of Cast Iron," by H. E. Diller, Chicago, Ill.

"A Plea for the Apprentice," by W. W. Gebb, Jerome, A.T.

"Notes on Bronze Founding," by C. E. Johnson, Dorchester, Mass.

"Nickel in Cast Iron," by Jas. F. Webb, Elkhart, Ind.

"Design for a Modern Pipe Foundry," by J. B. Nau, New York.

"The Induction Furnace."

In addition to the above a number of papers of special interest to brass founders were presented in connection with the meeting for the formation of the Brass Founders' Association.

Up to Tuesday evening more than 1,100 persons had registered at the armoury headquarters, and the indications then were that the crowd would reach the proportions of the record breaking one at Cleveland last year.

President's Address.

President McFadden, in an address that evoked enthusiastic appreciation, went more thoroughly into the work of the Association and the possibilities of its future than has been done on any similar occasion.

Finding soon after taking office that the Association was hampered by lack of funds, and that its income was dependent upon the dues of members, President McFadden devoted much effort to increasing the membership. As a result of this campaign, about 150 new members have been acquired in the past year. This, however, does not make the income of the Association sufficient to enlarge its work. It was recommended, therefore, that the dues, which at the New York meeting in 1905 were reduced from $10 to $5, in the hope of largely increasing the membership, be now restored to the original figure.

Report of the Secretary-Treasurer.

The Secretary, Dr. Richard Moldenke, who is also the Association's Treasurer, made the most gratifying report presented in the Association's history. We make the following extracts:—

"Thanks to the well-directed efforts of our President, Mr. McFadden, the membership of our Association has grown in the past year fully 75 per cent. Our Vice-Presidents and Mr. Lane, of the Foundry Supply Association, have also assisted your Secretary materially in bringing up the membership, so that today we are 532 strong. The financial situation of the Association is also an excellent one. The income for dues, sales, etc., has been $2847.45. The expenses were as follows:—

	Dols.
Transactions	303.41
Salaries	1,200.00
Printing	198.35
Postage	383.00
Sundries	8.75

This leaves a balance of $753.94 in the treasury. While the balance looks large, most of it is on account of dues paid in advance for the coming year by the new members just received. The result is, nevertheless, highly gratifying, and augurs well for the future of our work.

—o—

THE dismantlement of the Berryhill Iron Works continues, the machinery having been acquired by T. W. Ward, Limited, of Sheffield.

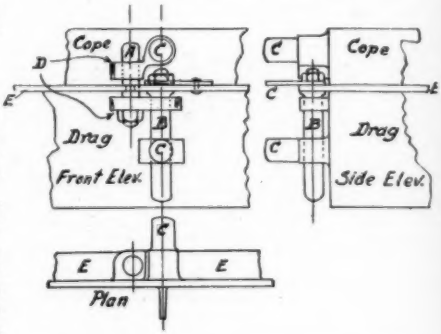
A CHEAPLY-MADE EFFICIENT, FIRE-BAR RIG.

By G. M. R.

THE making of standard fire-bars from loose patterns and odd boxes had become anything but a pleasant occupation, so after duly considering the circumstances it was decided to make a new "one man" rig out, as follows:—

Boxes or flasks, 3 ft. 3 in. long by 2 ft. wide, to take eight bars each and allow room for runner at one end; drags to be 6 in. deep and copes 2¾ in. deep. A light overhead trolley and runway, with a sure grip-rope block, was installed for lifting the boxes, turning over drags, drawing patterns and shaking out.

The eight patterns cast in aluminium



alloy from the master wood pattern were fastened with the runner to a ¼-in. steel plate.

Referring to the sketches, which are intended to show the details of the flask pins A, pattern guides B, and lifting centres C—which in all respects are similar at each end of flasks—it will be seen that these lifting centres are directly in line with each other, so that the lifting sling or bail—made from ¾-in. round rod—can be managed with one hand, while the rope blocks are operated with the other when lifting either the drag, pattern plate E, or cope. On the drag is cast an elongated lug, having, in addition to the hole carrying the flask guide pin, a guide hole, for the pattern plate guide pin B, which latter also passes through a second hole formed in the extended lifting centre of the drag.

These pattern guide pins, 6 in. long and 1 in. diameter, turned from mild steel and firmly fixed in the pattern plate, formed the main feature of the tackle, as

it took the place to all intents and purposes of a moulding machine, at a much less cost, and which, in practice, answered the purpose very satisfactorily.

It may interest some to know that the lug and lifting centre, with all the holes, were cast on the drags by means of a dry sand block made from a special core box, the cope pin holes being formed in the pattern to leave their own cores; one of these latter being round to fit the pin, and the other elongated to allow for the uneven shrinkage, springing of pattern, etc.

Further, the surfaces of the lugs indicated by the letter D in the sketch, were slightly tapered from the flask to admit of wrought iron clamps—forged to a die—to be lightly driven on whilst casting.

In working, the pattern plate is laid on a board, drag placed on, and rammed up, turned over, and lowered into soft bed; cope put on and rammed lifted, and stood on edge, pattern plate and patterns lifted and laid back on the rolling board ready for next drag, etc.

All the operations are performed entirely by one man, even the rapping of the pattern plate with one hand while drawing the patterns with the other; also the shaking out and stacking the flasks.

The cost of making bars with this comparatively inexpensive tackle is just 50 per cent. less than by the old way.

——o——

RICHARDSON, WESTGARTH & COMPANY, LIMITED, have lately installed in the boiler-making department of their Scotia Engine Works, Sunderland, a hydraulic stationary rivetter of large power, which has been supplied by Messrs. Hugh Smith & Company, Glasgow.

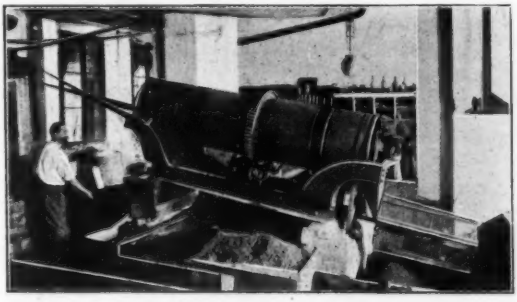
A NEW METHOD OF PREPARING FOUNDRY SAND.*

BY MONSIEUR E. RONCERAY, Paris.

MOULDING sand is composed of grains of silica of various sizes and shapes, and of alumina or clay, which is generally in a very fine state. Besides these ingredients, moulding sand contains impurities such as oxide of iron, lime (sulphate or carbonate), magnesia, etc.

The ideal sand should be composed exclusively of grains of silica, with a coating of clay as thin but continuous as possible. Such a sand would be very refractory and very porous if the grains of silica were of convenient size and the coating of clay thin enough.

Let us take commercially pure silica and mix a certain amount of clay with it, and obtain, as near as possible, a mixture like foundry sand. If we take a handful of this mixture it is easy to see that it has no consistency, no bond.



CONTINUOUS SAND MIXER.

Let us rub it by hand for two minutes, and take a sample, then repeat the operation several times. If we compare these samples, it is easy to see that with more rubbing we get more bond, and, after a certain time, we arrive at a condition in which the bond will cease to increase. By this operation each grain of silica receives a better coating of clay. All this has been accomplished without the common, tedious work of preparing sand by drying, pulverising, mixing, etc., and this very simple experiment gives us a new method of obtaining good moulding sand, even if good pure deposits are not at hand. Silica sand is found nearly everywhere, and there is no difficulty in

* Paper read before the American Foundrymen's Association.

finding a clay convenient for this purpose. To obtain the proper result, the rubbing must be perfect, and it is to put this idea in practice that we have designed our automatic sand mixing and rubbing machine.

This machine uses wet sand as it comes from the quarry, without requiring any previous drying, mixing or screening. The quality of sand obtained is always alike, and is delivered by the machine ready for use without any additional handling.

The principle of the machine is new. A barrel slightly inclined is mounted on rollers as shown in the accompanying illustration, and by means of a suitable drive is caused to revolve slowly. The barrel is divided into two chambers, the first one receiving the sand after it has been roughly mixed and moistened on the floor. It is then thoroughly mixed in this chamber by the rotation of the barrel and passes into the second chamber. There several lines of rollers of different sizes take the sand, rub and work it. A scraper which is kept in contact with the barrel by a weight detaches the sand which adheres to the sides. It then falls between the rollers and is worked over and over again.

The sand then passes slowly to the end of the machine where, after passing through a wire screen, it falls to the floor finished and ready for use. In some cases we have found it an advantage to use a small disintegrator before screening. The sand obtained is then very light and porous.

—o—

CAST THREAD FITTINGS.*

By Henry B. Cutter.

When the request of your Secretary was received to present at this Convention the subject of making grey iron castings that did not require machining, it was stated that foundrymen throughout the country were much interested in the subject. While acceding to the request, it seemed almost presumptuous on my part to undertake the presentation of such an important subject particularly as your author's experience in foundry work covers a period of less than four years. I have been assured, however, of your kind consideration and friendly criticisms.

* Paper read before the American Foundrymen's Association.

The principle and method of making grey iron castings with threads cast in them was evolved by George Cowing, of Cleveland, about 1878. The development of castings thus made was coincident with the development of the pump industry, in which Cowing & Company, Seneca Falls, New York, were leading factors. This method of making castings with cast threads was applied to the manufacture of pumps where different parts were to be screwed together, and was employed exclusively by this Company in its works from the time of its inception to the practical abandonment of the business. It was found to have been a marked point of economy in the manufacture of pumps, and enabled the manufacturers to produce superior goods.

The making of grey iron castings with cast threads was for many years an incident correlated to the manufacture of pumps, but since the organisation of the Cast Thread Fitting and Foundry Company, the making of grey iron fittings with cast threads has been carried to a much higher degree of perfection than had hitherto been thought possible, both as to quality and economy in methods of production.

Recent tests with a number of these fittings screwed together with wrought iron pipe having standard gauge cut threads, the joints having been made up without the use of any dope other than lubricating oil, showed no indication of break-down under a pressure of 900 lbs. to the square inch.

Erroneous opinions have existed among foundrymen in general regarding the method of producing castings with the threads cast in them, as it had been considered by many that it was done by the use of chills, thereby producing a hard brittle thread which would be liable to break in making up. This method, however, has not been employed.

The method pursued in making cast threads in grey iron fittings has been by the use of seamless sand cores formed without the fin or rib that is usually caused by the sections of a core box and which require dressing off. The threads of these seamless cores are formed in the sand by the use of special devices. The dies of the thread forming devices are made of high grade steel and are subjected to a minimum amount of wear. When once made to standard gauge they will produce duplicate thousands of these seamless thread cores without variation, and being thus made, are perfectly round.

The seamless thread cores are then

joined with the ordinary plain or body cores by the use of arbors, and are placed in the mould the same as ordinary cores. The special mixture and the fineness of the sand from which these thread cores are made, produce a clean sharp thread in the casting. The methods employed in uniting the thread cores with the plain cores are such, under improvements recently put into operation, as to render it impossible for the threads in the castings, where they come at opposite ends of the fitting, to be out of alignment.

It has been claimed that the contraction of the metal from the time it is poured into the mould until the cooling of the casting would produce sufficient shrinkage to render the making of cast threads unreliable and variable. Such a condition, however, does not exist in practice, and is perhaps due to the fact that the solid core prevents a shrinkage which might otherwise occur. The metal in the threads of castings thus made is of the same structure as that in the body of the casting, only having on the surface of the thread a thin film present on all grey iron castings. This film proves to be of great benefit in practice, as it is harder than metal where the film is cut away, as is the case with standard threads cut on pipe. This cast thread being standard, true to gauge, and possessing the hard film of the casting, forces the cut thread of the pipe into a perfect union.

Regarding the iron used in making grey iron castings with cast threads, ordinary foundry practice is pursued, care being exercised in the mixture of the iron, which, when carried out by the usual methods of mixing by analysis, produces clean, sharp threads.

—o—

THE new establishment at Tranmere Bay of Cammell, Laird & Company, Limited, including the old premises, occupies upwards of 115 acres, the engineering and boiler-making buildings covering an area of 217,000 sq. ft. These shops have been equipped with cranes capable of dealing with loads up to 150 tons. Beyond the engine shops are the platers' sheds and the building slips, the former covering an area of 145,000 sq. ft. The motive power of all the machinery is electric, produced by gas engines driven by Mond producer gas, and direct coupled to the electric generators. There is also a complete installation of hydraulic and pneumatic power.

FOUNDRY DESIGN.*

BY F. A. COLEMAN.

A FOUNDRY is a machine composed of a number of parts, each part having a certain duty which should be performed in harmony with the other parts. This machine should be housed in buildings erected to suit the machine.

Raw materials are received or fed into the machine at certain places and the output is finished castings. We think this statement covers the foundry proposition; if it does, we are led to believe there are some peculiar methods employed by many foundrymen.

A foundryman desiring to buy an engine does not go to the engine builder and ask for an engine large enough to fill a building 30 ft. by 40 ft., but he tells him he wants a certain power and type of machine. Nevertheless, many foundries start with the size of the building and work backwards to the machine they desire to house. It is this illogical method of building foundries that has tempted the writer to prepare this paper on "Foundry Design," not with the idea of trying to write a treatise on foundry buildings, but of trying to help in the design of the foundry machine.

Many statements made herein will undoubtedly be questioned by foundrymen because they will not line up in all cases with certain exact and known conditions, but general conditions are being discussed and necessarily general statements must be made; therefore the attempt will be made to treat the subject in a very broad manner.

One expecting to enter the foundry business may have a certain fixed sum of money to invest and desires to produce the best results from this investment; or a certain limited piece of property is to be used and it is necessary to produce the greatest output from the area; or it is desired to produce a certain tonnage of castings. Ordinarily, any one of the above three conditions will explain the beginning of a new foundry, and a careful study will show that in no one of them should the building be allowed to become the determining factor in the design of the machine.

The writer claims that the buildings are drawbacks to the foundry; they keep out light, complicate the ventilation, and are in the way generally.

* Paper read before the American Foundrymen's Association.

Problems of Foundry Design.

It seems as if there are but three problems to be solved in designing a foundry, which may be stated as follows:—

I. Given a certain sum of money, to produce the largest and most efficient foundry, or

II. Given a certain area of land, to produce the greatest output efficiently at the least expense.

III. Given a certain desired output, to produce the highest efficiency at the least expense.

The general problem is to produce the greatest result with the smallest expense. This, of course, is what all foundrymen are seeking to do.

There are many kinds of foundries, and while it is not really necessary in discussing this subject to name them, yet it may be of interest to see how many different lines of foundry work are carried on.

A classification according to metals follows:—

I. Iron.
II. Steel.
III. Brass.
IV. Aluminium.

I. Iron foundries produce grey and malleable iron castings.

II. Steel foundries produce acid, basic and crucible steel.

III. Brass foundries produce all kinds of alloy castings, of which we may assume copper as the base.

IV. Aluminium foundries are almost universally a part of brass foundries and produce alloys containing high percentages of aluminium.

Classifying according to methods of melting and avoiding the unusual or experimental methods we have:—

I.—IRON—
Cupola furnaces.
Air furnaces.

II—STEEL—
Open-hearth.
Converter.
Crucible.

III—BRASS—
Crucible.
Direct melting.

IV—ALUMINIUM—
Crucibles.
Direct melting.

Classifying as to fuels we have:
I—IRON—In the cupola furnace—
Coke.
Coal.
Charcoal.
In the air furnace—
Coal
Gas.

II.—STEEL—In the open-hearth—
Gas.
Oil.

Iron melted in the cupola for the converter, with cold blast.

In the crucible furnace—
Soft c a'.
Oil.
Gas.

III—BRASS—In the crucible furnace—
Coke.
Hard coal.
Soft coal.
Oil.
Gas.
In direct melting furnace—
Oil.
Gas.

IV—ALUMINIUM—In the crucible furnace—
Oil.
Gas.
Coke.
Direct melting—
Coal.
Oil.
Gas.

Classifying according to character of work:
I—IRON—
Jobbing—light work.
Jobbing—heavy work.
Architectural.
Hardware.
Stove plate.
Soil pipe.
Water and gas pipe.
Car wheel.
Pipe fittings.
Machinery.
Electrical.

II—STEEL—
Jobbing.
Electrical.
Machinery.
Marine.
Railroad.

III—BRASS—
Jobbing.
Ornamental and art.
Lighting fixtures.
Architectural.
Hardware.
Plumbers' and sanitary supplies.
Steam and hydraulic.
Marine.
Bell.
Automobile.

IV—ALUMINIUM—
Jobbing.
Automobile.

These classifications are not supposed to be complete or exact, but on examining them it will be readily seen that many of these points enter into the foundry design. The foundryman should therefore settle a number of them before considering going ahead with a foundry proposition.

Classification of Work.

The foundryman should determine as closely as possible the class of work he expects to make and the process he expects to use in making it; if the class of

work to be made is definitely known, the problem is simplified; too much importance cannot be laid upon this fact because the foundry can then be designed to meet known conditions.

It makes no difference what a foundry may make, all foundries have three general operations which are:—

A. Melting.
B. Moulding.
C. Cleaning.

A. All materials, processes, equipment and labour necessary to produce molten metal in the moulds are included under this head.

B. All materials, processes, equipment and labour necessary to produce a form of mould for receiving the melted metal come under this head; as cores are a part of the mould, core making is included.

C. All materials, processes, equipment and labour necessary to remove adhering moulding metal and excess metal not a part of the actual pattern come under this head.

According to this arrangement the melting cost would be the cost of the metal in the mould; the moulding cost would be the cost of the moulds and cores ready in the mould; the moulding cost would include the removal of the rough castings from the mould, making it like the actual pattern and delivering to the shipping room; a number of overhead expenses would, of course, be chargeable to these three operations.

Automobile and Marine Engine Cylinders.

We may assume the case of a foundryman who desires to make automobile and marine engine cylinders; he either knows from his experience or finds on investigation that he can produce the best castings with the air furnaces; this, of course, determines his method of melting.

He next finds that he can depend, or will have to depend, upon the business of certain customers, and that it will be to his advantage to make the work upon some style of moulding machine.

If he builds his foundry upon this last assumption, and finds the business comes as he expected, then he will get a certain output; if he has been wrong in his assumption, and he has to resort to bench or floor moulding, then his output per moulder will be reduced.

The first assumption would require a certain melting capacity per moulder, while the last would require a smaller melting capacity per moulder.

There are, of course, many points involved in the output of a foundry, but it may be roughly stated that the output divided by the area will be constant for the same line of work.

There are exceptions to this statement, of course. In a brass shop making sanitary work in iron flasks, the moulds if poured flat may be stacked three and four high; if poured on end they cannot be stacked and the output of a moulder will require a much larger area.

The endeavour is being made to show that many things are peculiar to each metal and to each method, and therefore all these points should be taken up and settled as a part of the preliminary work. It is admitted that at times no one can determine what should be done, but it is to the foundrymen's interest to reduce the elements of the unknown and the uncertain as much as they can.

Foundry Lay-out.

It can now be assumed that the foundryman has definitely decided to make a certain line of work in a certain way, and is ready to design a foundry machine which will give him the greatest output of good castings for the least cost.

He should have a map of the property showing streets, alleys, railroads, etc., if the property is, or may, be affected by buildings adjoining, these should be noted.

If the area is large and the surface is irregular it may be necessary to make a topographical survey of the tract, but it can be set down as a fact that a careful study of the property itself will show that certain advantages may be gained by designing the foundry with reference to these property conditions.

A building 70 ft. by 100 ft. may be designed and do very well on a ten acre lot, but will be a failure on a lot, 70 ft. by 100 ft., surrounded by high buildings in the city.

The amount of metal to be melted to produce the tonnage of finished castings, and the number of moulders necessary to handle the metal are next determined.

From this we find the area required for the furnaces, moulders, core makers, core ovens and cleaning; the areas and capacities of the storages for metals and fuels are found; the storage of the flasks, moulding and core sands, etc., may be determined; furnaces, moulders, core makers, and cleaners supplies should have a place and require areas which should be determined; pattern and machine shops; pattern storage, locker

and wash room; closets and urinals; sand preparation rooms, shipping room, room for holding castings to see if orders are completed; foundry foreman's office; main office; power plant and laboratory; it may be necessary to consider all of these.

Certain operations requiring floor space are necessary to every foundry; some of the things noted are needed by some foundries, and all such areas should be determined as closely as possible.

The determination of the various areas required, and such other information as is peculiar to each foundry, places the foundryman in position to start the actual lay-out of the foundry.

Arrangement of Areas.

The problem now is to make an arrangement of these various areas which will permit of the movement of the materials through the various processes of melting, moulding and cleaning, and deliver the finished castings to the shipping room with the smallest amount of labour, the minimum amount of equipment, and the lowest cost.

The storages for all materials received should be close to a central unloading point where they are to be used. The first statement is particularly true of foundries served by sidings.

Fuel and metal should be very accessible to the furnaces. Sands should be convenient to the core room and the moulding floors. They may be passed through the sand preparation rooms and then be distributed to the core room and the various moulding floors. Likewise the core ovens should be close to the fuel, and the core room located so as to serve the foundry without unnecessary handling of cores.

Core Departments.

In foundries served by cranes, the ovens should be arranged so that the cores may be handled from the cars by the main bay cranes into place.

This does not mean that the main cranes should be used to load cars, which may be done by core bay cranes. It is not profitable to bake large and small cores in the same oven; the best results are obtained, both in baking and in fuel saving, by baking bench cores in small ovens and floor cores in large ovens. If possible the small core racks should be placed on the division line between the core room and the foundry and accessible to both.

Charging Floors.

In the foundries where the charges are hoisted, the charging floor should be large enough to carry at least one day's supply to avoid shut downs. In heavy shops running two or more cupolas side by side, they should be spaced so that two cranes may serve at the same time; pits should not be located in front of the cupolas.

Provisions should be made for the handling of the ladles at the cupolas by small cranes so as not to tie up the main bay cranes.

It is best to pull the heavy and mould core cars by haulages independent of the cranes; the heavy cranes should not be called upon to do all kinds of work, which can be better done by lighter and cheaper equipment.

All areas should be regular in form, and not cut up, post or columns should be avoided and should be kept off the moulding floors or placed at division lines between bays or floors.

Taking up the form of construction best adapted to foundry purposes, it would seem that of two types, the one which will give the greatest amount of light and the best ventilation should be the one to adopt.

Crane loads and roof loads should be carried directly through columns to the foundations; there is no reason for requiring the actual walls to carry loads.

Light and Ventilation.

Every foundry requires all the light it can get, and ideal results are obtained when there is nothing but glass from the sills to the eaves and a continuous line of glass from end to end.

The lanterns, or monitors, should be wide and high; a narrow monitor is about as expensive as a wide one, and not as effective.

The general form of construction as above recommended, is so simple and good that it does not seem necessary to mention it, and yet the majority of foundries are much more costly and do not produce as good results.

In addition, whitewash or cold water white paint are worth many times the cost.

If the foundries will wash the windows but once a year they should do it in October, and not in the spring; many a foundry can declare a dividend with the money wasted on lighting, when nature stands ready to do it for nothing, if only given the chance.

Do not, under any consideration, build

any kind of a foundry to do any kind of work with less than 14 ft. outside walls, a single bay foundry 50 ft. wide should be not less than 16 ft. high on the sides.

When floors are to be paved in the foundries, good concrete will give first-class results. The writer is fully aware that the above two statements will be very severely criticised.

Power.

Foundry power is a question which interests many. Shops requiring a small amount of power in the cities can often buy power from the electric companies to good advantage; this is particularly true when there is a large fluctuation in the quantity used.

The number of producer gas engines will increase in the foundries as there are many points in their favour; probably the majority of foundries use less than 100 h.p. The building of successful bituminous coal gas producers in units as small as 125 h.p., together with the present reliability of gas engines, are strong factors in making this increase.

Locker and Wash Rooms.

The modern foundries consider locker and wash rooms as necessary; they should be used for washing and dressing rooms only, and should be in charge of some one at the time the men are going to and leaving work.

The closets and urinals should be located so that it is not necessary for the men to leave their floors; the saving in lost or loafing time is worth the additional cost.

In the larger plants a room for the holding of patterns on their way to the foundry is a convenience. Patterns are thoroughly overhauled to know that they are in condition, with all parts, core boxes, etc., accounted for.

Cleaning Department.

In foundries running a large number of pieces of the same pattern, a casting cleaning room has many points in its favour; castings are turned into this room from the foundry; they are counted and inspected and any shortage must be supplied by the foundry; this avoids congesting the shipping room with incomplete orders. In shops having factories, this room really becomes a store house where requisitions from the factory are filled.

The foundry foreman's office should be located convenient to the foundry to give a good view of the plant; in larger shops requiring a number of sub-foremen, this is not so important.

Distribution of Power.

The distribution of power throughout the plant by motors does away with the necessity of making the location of the power plant a factor in the design of the foundry. The pattern shops, flask makers' shop and machine shop are not an actual part of the foundry, and while it may be necessary to consider them, nevertheless, the foundry lay-out should not take these into serious consideration.

The actual foundry provides for melting, moulding, and cleaning; everything else which may be necessary is subsidiary and should give way.

The writer desires, however, to qualify the above statements with reference to foundry plants which are designed to occupy the entire area of the property, and where the greatest output must be secured from this area. Under such conditions everything must be considered as a part of the whole, and it becomes somewhat a case of give and take between the various departments.

The east, with its older foundries and closely settled localities has been, in many lines of work, forced or led into the construction of foundry plants of two or more stories.

The west is beginning to do the same thing under the same stress of conditions; the melting, moulding and generally the core making are carried on on the top floor; cleaning, sorting and shipping and other operations being done on the lower floors; such foundries are generally engaged in light work only.

Building Materials.

Of the materials of construction it may be said that brick is mostly used with wood or steel framing. Fire-proof construction is increasing; the foundry with its furnaces, ovens, hot metal and careless class of employés is peculiarly subject to fires; that this fact is recognised by nearly all foundries is shown by the construction of the fire-proof pattern storages.

Oftentimes the destruction of the plant itself during the rush season is fully as serious as the loss of the patterns; this is true of jobbing foundries where customers generally insist upon the delivery of their castings, fire or no fire.

In small or light shops, floors should be planned to give each moulder a certain area which can be served very readily with metal either by trolley system or

some other method which will take the metal quickly and without confusion to each area.

The great need for designing plants, not only for the present but for the future, is shown by the large number of foundries, which have a main foundry and a vast litter of dog houses; many foundries are not thoroughly christened until they add such a dog house. But they are expensive; they break up the routine, require extra foremen, and generally rob the main foundry of its share of light.

The writer believes that the foundryman should thoroughly study his plans on paper; each problem has an answer which can be more cheaply worked out on paper than on the ground.

It should be remembered that profit is the ultimate end; profit produced by making good castings at a low cost.

The fixed charges should be kept down. Bad design resulting in the expensive handling of materials means useless fixed charges, limited output, and, of course, too high a cost.

Many an expensive investment in equipment or makeshifts could have been avoided in many foundries by the proper designing of the original plant. Many foundrymen now keenly realise that what appeared like a saving in construction has resulted in a heavy cost for operation.

——o——

A FEW DENATURED BRASS FOUNDRY NOTES.*

By Wm. H. Parry.

To melt copper with a little tin and spelter or lead added on the side, can be accomplished by most anyone who has metal, fuel, oxygen, and patience.

To melt any of the non-ferrous alloys, however, in a manner calculated to insure economy, combined with the best results, calls for no little skill, as anybody addicted to this habit can testify.

For the man who attempted to colour his mixture of 90 spelter, 6 copper, 2¼ tin, and 1¾ lead, with four quarts of the fifty-seven varieties of tomato soup there is no hope, neither is there any room in heaven for the men who will persist in trying to achieve known results from unknown quantities and qualities of ingredients, as well as unknown pouring temperatures and fuel properties.

To properly melt brass or bronze is a trick not to be learned in five minutes, for the very excellent reason that conditions vary greatly, and what might be the correct fuel and temperature for one class of castings would not be at all suitable for others. While it is practically impossible to lay down set rules for the guidance of melters in general, it may be well to cite a few instances that will at least prove that one is never too old to learn.

A Few Experiences.

After many unsuccessful attempts to pour a certain casting of peculiar design from metal melted in an oil furnace, it was found that when the ordinary floor crucible furnace using coke as fuel was used to do the melting, the resultant casting was good, thus proving that for thin castings covering a great area, and of broken or staggered section, the oil furnace cannot be used successfully, because of excessive oxidation, which traps the metal before it can flow to the outermost recesses of such a mould, which in this case was dry sand—the most favourable condition. Now, the deductions from this instance are easily arrived at; first, oxidation due to method of melting, as air at 18 ozs. is admitted in constant volume for from 60 to 90 minutes, according to the weight of charge, with resulting non-fluidity, though it is possible to have a melted metal very fluid, yet with a proportionately greater affinity, either forced or natural, for oxygen, in which case poor castings will occur with distressing frequency, no matter what may be the design or the deoxidising agent used.

At another time it was desired to cast an order for pump cylinders, 88 copper, 10 tin and zinc. After losing five castings in succession—though outside indications were favourable — the melter's method was looked into, and it was found that he was more fitted to mix mince meat at a bakery, as he believed in melting the whole mass as one, and not adding his tin and spelter at the proper time.

The trouble here was porosity, and it was not altogether due to the ignorance of the melter at that, as the pouring temperature was too high, and when both the melting method and temperature were regulated, the castings made were perfect. Again, it is possible to pour metal at too low a temperature, either from insufficient time in the cooking, or waiting too long after the cooking thereof, porosity again being conspicuous, even

* Paper read before the American Foundrymen's Association.

more so than from overheating. No less an authority than Percy Longmuir states that, assuming the mixing and melting of alloys to have been thorough, the success or failure in casting is entirely a matter of the pouring temperature.

Wedge Test.

A very practical and interesting test for fluidity, proper casting temperature, and the necessity for or the non-use of risers, is the wedge test. Have a wedge pattern made, say, half an inch thick at one end, to nothing at the other, 15 in. long, and about 2 in. wide, gated at the butt end. Cast the same on the flat from metal melted in any oil furnace, and one from the ordinary floor furnace, using crucibles and coke fuel, assuming the temperature at pouring to be same, it will be found that the crucible metal will have run much closer to the point than the other, thus proving to be more fluid.

Again, make two moulds from same wedge pattern, arranged to be cast one end—point up—and gated at the lower or butt end. If too hot the casting will show that while the metal could climb up, it could also "eat in" even at the point, while if too cold it could neither climb nor eat.

By making the wedge castings both with and without risers, and placing moulds at different angles for pouring, the results point invariably to the necessity for the use of risers on all classes of work, though it must be said that proper venting is an essential not to be despised.

It is hardly necessary to explain that these inexpensive test moulds, to be conclusive, should be made with sand taken from the same heap, and in every way to be tried with fairness.

Metal Patterns.

The making of metal patterns in this age of moulding machines has assumed proportions little dreamed of but a few years ago. Many articles published in the technical press have enthusiastically advocated the use of aluminium as the ideal metal for use as patterns, even going so far as to state that in addition to its lightness the surface presented to the sand was vastly superior to any other metal. Now this all sounds and looks good, but an experience of eight years with this metal as used for patterns compels the statement to be made that it is both a delusion and a snare any way you look at it, either as a pattern metal or constituent in alloys.

Use of Aluminium.

As a pattern metal, when it is claimed that the metal is easily handled because of its lightness, all of its good qualities stop right there, as in addition to being hard to cast properly, owing to abnormal shrinkage and oxidation, it is probably the very worst metal known to turn, plane, file, or scrape, and if after three times as much time is spent on the patterns than would be the case if good red brass were used, we have patterns that are to be a fruitful source of annoyance while in use. The surface is readily attacked by the moulding sand, and becomes in a very short time about as smooth as No. 2 sand paper. The effect on the castings from such patterns can better be imagined than described.

Aluminium as a constituent in non-ferrous alloys to add tensile strength is to be avoided, no matter what the makers claim for it, as practice has taught us that while it certainly does increase the tensile strength of the copper and brass mixture approximately to that of steel (if you can find a sound part of the casting to test), yet the difficulties encountered in producing sound castings, such as oxidation, shrinkage, and the necessity for a pouring head of sufficient volume and height to feed the mould, removes it as a possible factor in the successfully conducted foundry. Until some practical process of pouring moulds in a vacuum is invented, it will be good policy to shun the use of this metal, yea even to scrutinise and analyse the scrap we buy for its presence which, even to the one-hundredth part of 1 per cent. will make trouble for any foundryman if he doesn't know it's there.

It is a fact worth noting that in some districts at least, brass foundrymen are prone to use iron flasks on work that could readily be handled by snap flasks. When one sees foundrymen making shallow and light castings in iron flasks, and a couple of 30-lb. weights on top of the mould, it is enough to make Rome howl, yet this is entirely true of the practice in this part of the country.

This is a matter worthy of the attention of brass foundrymen, as it is beyond question that at least 50 per cent. of tub moulds could be made in snap flasks successfully, and with economy.

To carry economy further, the use of carded patterns on repetition work coupled with snap flasks very often produce results that equal some moulding machines in speed, and excel them in the

quality of castings, this being explained by the fact that the snap moulds were hand rammed and facing sand was used.

There are many other peculiar practices prevalent in our brass foundries, but now that the brass foundrymen are getting together it is highly probable that advancement will date from the present, and up-to-date knowledge will be spread broadcast for the benefit of such brass foundrymen that need it.

—o—

SHOP KINKS OR SHORT CUTS, AND DON'TS *

By the Cleveland Club of Associated Patternmaker Foremen.

In no trade more than in pattern-making does the individual have the opportunity to develop his original ideas and carry them to a successful issue, yet there are many pattern-makers who are content to follow precedent and do certain jobs to-day in a certain way just because they saw someone else to a similar job in like manner years ago, regardless of the fact that a shorter method may be found, if sought.

It is the object of this paper to keep the pattern-maker thinking along new lines, to show this by a few examples, and to impress it particularly by a series of "don'ts."

For instance, we may say, "Don't forget those simple geometrical problems that you learned years ago while at school (we use the term years ago advisedly) that you may need to-day." But don't always follow the roundabout way of working that may have been taught you by the professor. How many pattern-makers waste time and brain power, for instance, struggling with the simple problem of striking the ellipse.

Striking an Ellipse.

Various and curious have been the devices contrived for delineating the contour of an ellipse, and the fact does not seem to be universally known that the true way is the simplest. Fig. 1 shows how this can be done with the ordinary steel square, or, in fact, almost anything that is handy, having two of its edges at right angles, and a thin stick, about ¼ in. by ½ in., a little longer than one-half the major diameter of the ellipse.

Take the pieces on which you wish to lay out the ellipse, mark off the centre lines, also the major and minor diameters,

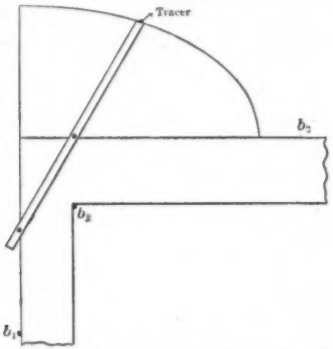


Fig. 1.—Striking an Ellipse with a Square and Tracing Bar.

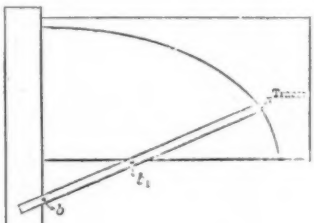


Fig. 2.—Striking an Ellipse with Two Pieces of Wood and a Tracing Bar.

transfer the lengths of the semi-major and semi-minor diameters to the stick, driving in two fine brads at these points. Next, place the square on the centre lines, the intersecting outer edges at the centre of the ellipse, drive in three small brads as shown at b^1, b^2, and b^3, which will secure the square in position. Then, placing the stick in position, the two brads will project through the under side slightly less than the thickness of the square bearing against the two outer edges, move carefully to the right and the tracer will mark out one-quarter of an accurate ellipse. The draughtsman

* Paper read before the American Foundrymen's Association.

can do the same thing on his drawing by utilising his set square or triangle and thumb tacks, two pins and sliver.

Different Application.

Fig. 2 illustrates the same principle, the application being slightly different. Take a piece of wood, large enough to make one-quarter of the ellipse, trim off

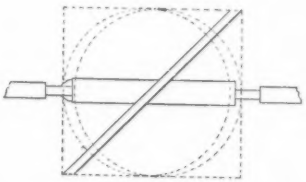


FIG. 3.—TURNING AN ELLIPTICAL VALVE.

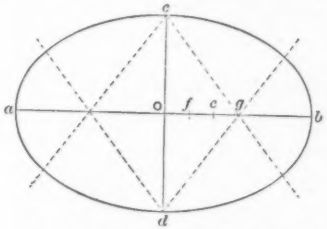


FIG. 4.—APPROXIMATE METHOD OF DRAWING AN ELLIPSE.

one end square with one edge, place the end against the edge of another piece of the same thickness straight on one edge, and brad them lightly to the table. Take a narrow strip and drive two brads through it as shown in Fig. 1. Placing the tracer at the end of the stick, draw to the right, allowing the brads to slide closely on the inside edges of the two pieces of stick, and the result is the same as secured by the first method; by simply reversing the pieces you can get the other parts, or you can cut out the quarter and use it as a templet. It is exactly the same as an ellipsograph and just as accurate; but how often do you rub against a pattern-maker with one in his kit? Some are minus other things more essential than an ellipsograph, but a few brads and a stick are always at hand.

Fig. 3 is an illustration of turning up in the lathe an elliptical valve which will fit accurately in a circular pipe at an angle of 45 degrees. Having the diameter of the pipe, which is the minor diameter of the ellipse, ascertain the major or long diameter by laying out the angle; cut out of a piece of stock an approximate ellipse the required thickness of the valve, leaving sufficient stock on the edges for turning off; then take two pieces large enough to take in the butterfly and tail stock centres and of sufficient length and rigidity, fasten them securely in the centre of the piece for the pattern, at an angle of 45 degrees, centre the ends and proceed to turn. It is not as difficult as it looks, the dotted lines in the sketch showing the exact contour of the edge as the piece revolves, and with a modern screw feed lathe would be easy. This is a very quick way, and will insure a perfect fit in the pipe.

Fig. 4 is a fairly good approximate lay-out of an ellipse by the divider route, $a\ b$ is the major, and $c\ d$ the minor axis of an ellipse. Space off $b\ e$ equal to the semi-minor axis $c\ o$, using $a\ e$ as the radius for the arc at each end of the minor axis. Bisect $e\ o$ at f and space off $e\ g$ equal to $e\ f$ and use $g\ b$ as radius for the arc at each end of the major axis. This is a very good approximate method, very nearly approaching perfection when the difference in length of each axis is not great.

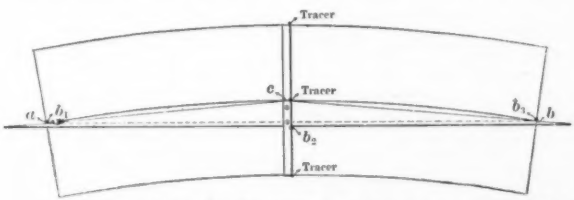


FIG. 5.—DRAWING AN ARC.

Arcs of Circles of Large Diameter.

To strike the true arc of a circle whose centre is inaccessible, or whose radius is so large that it is not practicable to strike it by means of a long trammel or rod, there is nothing to compare with a steel tape, using a chalk line for the radial lines. Fig. 5 is illustrative of a method which is accurate and also easily applied. It represents the three curves necessary for the layout of a bend pipe of a large

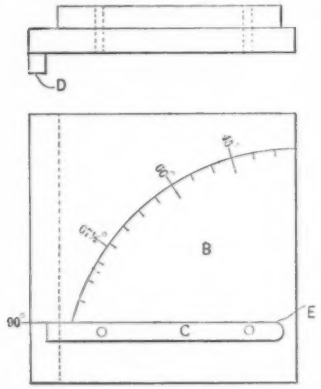


FIG. 6.—GUIDE BOARD FOR THE SAW.

radius. Having the chord line, it is first necessary to find the versin or the rise in the centre, which may be done by suing the following formula :—

$$\frac{d - \sqrt{d^2 - c^2}}{2} = \text{versin.}$$

Reducing this to shop lingo, it reads from the square of the diameter subtract the square of chord, then extract the square root of the remainder; subtract that from the diameter and divide by two. The answer is the rise of versin.

Next it is in order to cut a board in the form of a triangle, the base being the chord line as shown at *a b*, the apex at *c*. You will note from the sketch that it is necessary to extend the ends of the triangle at *a* and *b*, which is done by making the base line 1 in. below the chord line, parallel with it. In order to strike the three curves from the one triangle, it will be necessary to screw on to this piece a narrow strip in the centre at right angles to the base line, as shown at *c*, its length equal to the diameter of the pipe. Having laid out the centre chord line, place the triangle in position, driving into the table or layout board three brads, as shown at b^1, b^2, and b^3. Place the tracer at either point as marked and move to the right or left, taking care that the base of the triangle remains in contact with brad marked b^2, and if to the right with brad b^3, or if to the left with b^2 and b^1. The tracing point will delineate the true curve, and you will not have to go out on the street or require the area of a 10-acre lot to do it in, as we are informed has been necessary in some cases.

Advice for the Pattern-maker.

To the pattern-maker, we would say, don't be a shop knocker, but make the best use of the tools at hand; remember that only a very few shops are up-to-date.

When speaking of an up-to-date shop, most of our mechanics of to-day imagine that a shop of this kind must be equipped with a lot of new machines that most of them have never seen, or that take an age to learn to operate.

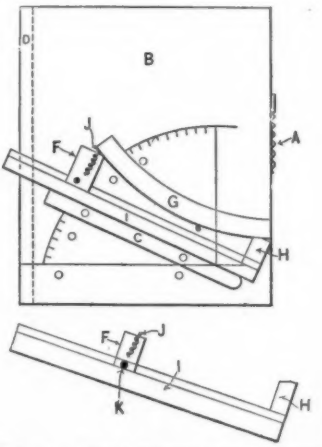


FIG. 8.—ATTACHMENT FOR SEGMENT WORK.

It never will occur to the workman that he himself should be an up-to-date mechanic, with new ideas, and that he should add to that ancient shop which has, perhaps, for years buttered his bread to his satisfaction. Instead, he often curses the old place as not being up-to-date, and characterises his employer as being too tight-fisted or too selfish.

The old saying is that there is no ocean so deep but that it has a bottom. The failure of the old shop in not putting out work to compete with others is not always due to the employer's selfishness. But getting down to the bottom is due to the workmen employed in such a place, for can you find such a shop-knocker that will even try to make the best use out of that machine which he already has?

Old machines are not always scrap or useless, just because there is a more modern one on the market; a little study given to the old machine will certainly improve it. For instance, take an old cross-cut saw table in running condition in a pattern-shop where the table has not been graduated so that octagon, hexagon, or mitre or other degrees can be cut on it, by placing the guide in position. This table is easily improved and made equal to the modern ones by simply applying a piece of board on which the segment of 90 degrees is laid out, as shown in Fig. 6.

To correctly make this board is simple. Take a board jointed and of parallel thickness the full width of the table, and place it at the left of your saw; screw or nail strip D, as shown in Fig. 6; place in slot, as shown in Fig. 7, and rip off to width. This done, take it to the bench and square from the ripped side and lay out the segment, as shown in B, with the centre a convenient distance from edge so that guide C can be seen crossing it.

This guide has two pins to steady it in different positions, without interfering with the edges; the one far enough in from the centre, so as to allow a number of holes on the different degrees in board B.

Place this guide-piece on the different degrees on board B and bore from guide C through board B. Put dowel pins in the guide C and the improvement is complete for any straight work to be cut to any angle.

The work is not always of a straight nature, and curves must be cut on angles of different degrees, as segments for rings, sometimes in quarters, sixths, eighths, twelfths, or any part of a circle. This is very hard for most workmen, and many of them waste more time in trying to butt these together than it should take to complete the work.

With a simple improvement to our first device, this can be done very easily in

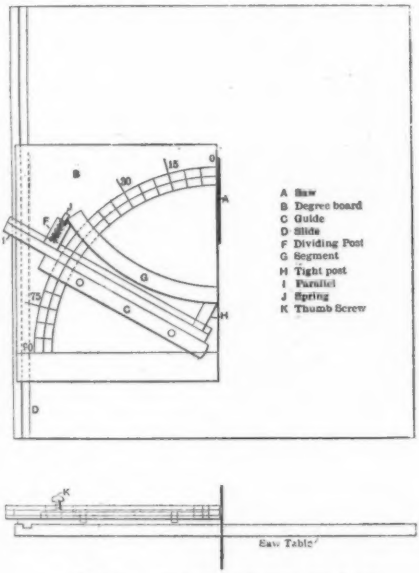


FIG. 7.—BOARD APPLIED TO SAW TABLE.

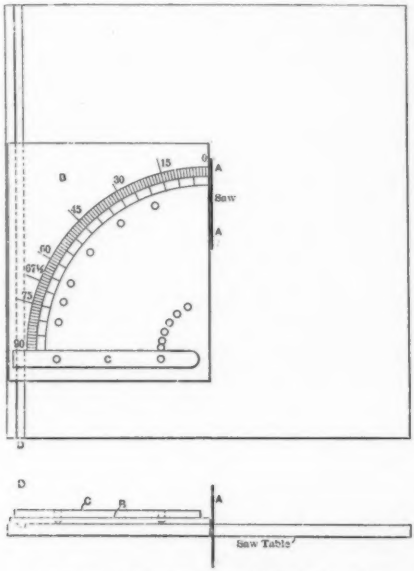


FIG. 9.—DEVICE WITH SEGMENT IN POSITION FOR SECOND CUT.

about one-tenth the time required for any other way and all hard labour will be avoided and a better joint will be made.

Another Improvement.

Improvement No. 2 can easily be added at a very small cost to the employer. This consists of a straight and parallel piece as shown in Fig. 8, placed on the device shown in Fig. 6, at the desired degree. It is easily made by the following method :—

Take a straight and parallel piece as shown at I, Fig. 8, of any thickness, and rip a tongue of about 1 in. on edge. Take two pieces marked F and H, Fig. 8, of the same thickness about 4 in. long and 2 in. wide, and groove to take tongue of piece I, cutting and fastening piece H tightly to piece I, as shown; then in F place an old-style window spring by boring a hole at J in F, as shown. Get a thumb-screw K and nut to fit it, cut a notch in the groove to receive the nut, and bore a hole that the thumb-screw will take the nut in the notch and tighten down on the tongue in I.

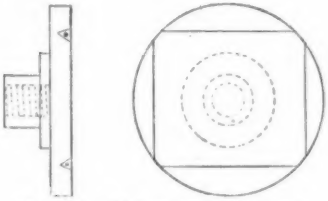


FIG. 10.—HOME-MADE SANDER.

In using it, the segment is first sawed on the band saw to the size required. A chord is found corresponding to the number of segments wanted for the circle; the length of the chord is made the distance between the spring piston J in F and the cutting point of saw or face of post H. The first cut of the proper degree is made with the spring drawn in with the segment, as shown in Fig. 8. The other end or length is cut by bumping the end already cut against the spring piston, as shown in Fig. 9.

Cheap Sanders.

Another very useful labour-saving device for this curved work is a cheap sander, which can also be rigged by the employé without great cost, as the lathe in the shop can be used.

Take the extra face plate, screw a disc to it, true up the face and turn to about 10 in. diameter; then get a sheet of coarse sandpaper and four pieces of leather or rubber about ¼ in. square; place your paper on the disc, first dampening slightly on the back, and bend the corners over the edge of the disc and tack it on through the leather or rubber. By placing a block on the bed within ¼ in. of the disc, and just to the centre of head of lathe, so that it can easily be removed and also tilted, it is ready for work.

This rigging can be used to good advantage for making a number of tail prints, discs, segments, round prints, and small, flat surfaces.

Band Sawing to the Line.

Don't start your job until you have it well in mind, or you may strike a snag later on.

Don't proceed with the pattern without noting the metal of which it is to be cast.

Don't fail to inquire whether the grade of pattern is temporary, medium, or standard.

Don't forget that the art of quick pattern-making lies in knowing where to slight it,—but

Don't form the habit of slighting everything. The man that can work according to his job is a valuable man.

Don't trouble the boss with fool questions. He has troubles of his own, besides you may expose your ignorance at the same time.

Don't try to get along without really necessary information on the job at hand, which the boss may have neglected to give you.

Don't make unnecessary layouts of work.

Don't take time to lay out a job, then not use the layout; properly used, it will save time on the job.

Don't fail to study economy both of material and time; both cost your employer money.

Don't miss checking up all dimensions on the drawing before proceeding with pattern.

Don't make a pattern without knowing how it is to be moulded, simply because the old man told you to do so.

Don't accept your first inspiration as to the moulding and construction of a pattern; try and think out another way.

Don't start a job you don't see through, expecting to get an inspiration as you go along. This idea wears out the floor between your bench and the old man's desk.

Don't construct large patterns without provisions for handling, shipping, or storing.

Don't be stingy with your core prints.

Don't be afraid that well-defined centre lines will spoil the looks of your job. They will look good to the checker, and to the lad who may have to change the job later.

Don't fail to put centre lines on your core boxes, as well as your patterns. A pattern, like bread that is cast on the waters, is seen again after many days, and it may be up to you to change it.

Don't look as pleasant as a calf's father when the boss gives you a disagreeable job. Do it cheerfully, and if you think he is rubbing it in, you can always quit; and if he really is, you had better.

Don't pick out all the snaps for yourself, when you have help on a job. However good you may be—

Don't forget there are others.

Don't despise the help of the apprentice on the job. He did not come in simply to learn to varnish, so let him do things. If he falls down, pick him up, and—

Don't forget you had your troubles, and when you are a has-been, he may help you.

Don't think that you know it all; there are other men that know a little.

Don't do by hand that which the machine should do, but you—

Don't have to wait your turn at the band-saw to cut off a toothpick.

Don't fail to study your machines and how to get the most out of them, but—

Don't take liberties or long chances with the jointer, especially when the knives are dull; better a few shavings round your vise than a crippled mitt.

Don't take long chances on the lathe, remember the adage, "An ounce of prevention is worth a pound of cure."

Don't waste time setting bevels for standard cuts that are arranged for on the saw table or trimmer. A little mental calculation and the indicator is better.

Don't think because you see a circle on the drawing that the work must be done in the lathe; other pieces fit sometimes, and

Don't forget that a sharp band-saw is a good tool, and sawing to the line not quite a lost art.

Don't use your material for a footstool before working it up. It's hard on the machines.

Don't wait until the rip or band-saw is just sharpened, then saw nails; if it must be done, do it before.

Don't swear when your plane hits a nail. The chances are you put it there yourself.

Don't sandpaper each piece as you put it on the pattern, then plane it afterwards. It takes time to sharpen tools, and—

Don't forget to buy your own.

Don't round up the ribs and corners of a pattern until all pieces have been assembled.

Don't throw too much work on the foundry, but occasionally a little stopping off saves time.

Don't leave the making of the stop-off piece to the foundry carpenter; he may not see things as you do.

Don't glue cross grain, for a distorted pattern is very apt to be the result.

Don't glue two pieces of wood together that have just come out of the ice box. It's too chilly on the glue.

Don't carry your tools in a collar-box and expect the steady pins to furnish the ones you haven't got.

Don't borrow tools and forget to return them, and especially

Don't borrow when the other man is not looking.

Don't go to work so loaded that everything appears double. It's hard to guess the right thing. This applies only to a few.

Don't assume any pattern is correct; treat them all with suspicion until proven.

Don't proceed with the alteration of an old pattern without first carefully checking it up.

Don't proceed with another workman's job without checking his measurements.

Don't use screws when nails will do the work as well; nails go quicker and are cheaper.

Don't forget that supplies and lumber cost money; if the other fellow is paying for them—so

Don't fail to practice economy, and

Don't lug in a 16-ft. plank and cut a 4-in. or 5-in. print out of the middle; it's easier to turn over the scrap pile.

Don't keep your bench so littered up that it takes five or ten minutes to find some small tool you just laid down.

Don't think because you happen to be a relative of some member of the firm that you are entitled to more privileges than any other man.

Don't try to do as little as you can for the most you can get, and—

Don't do any fooling during working hours; you are paid for working—not playing.

Don't fail to report promptly when your job is completed.

Don't stand around and look wise when waiting for a job. Get busy with your oil-stone. There are always tools to be sharpened.

Don't fail to check up your pattern when complete.

Don't leave your mistakes for others to find; find them yourself, and if you do—

Don't let them go on a chance of its getting past the checker. Be sure your sins will find you out, even if it does rope in the other lad.

Don't say "that is near enough."

Don't fail to number and place location marks on all loose pieces of pattern and core boxes.

Don't forget to place a marker upon the core print, if the core can be reversed.

Don't fail to nail the lead letters and numbers on the pattern. One nail in each letter is not enough to insure them staying right side up.

Don't number the core boxes upon the face of box; sand in time will wear it off.

Don't size up your job and guess at the amount of lumber; keep account of the boards as you cut them up.

Don't forget that an easy way to figure lumber is to multiply the length in feet by the width and thickness in inches, and divide by 12. Example: 9 ft. by 8 in. by 1½ in. divided by 12 equals 9 ft.

Don't forget to mark upon the side of core boxes which way lifting hooks for the cores are to be placed.

Don't forget to mark the length of standard cores upon the pattern, when used. This saves the moulder's time, as well as the core-maker's.

Don't waste time doing unnecessary work.

Don't spend time and money giving patterns a piano finish. They are not used for ornaments.

Don't get into a rut of doing any certain work; try and improve upon your method, as well as lessen the time.

Don't think you know more than the boss, even if you do.

Don't expect the highest wages, unless you can produce the goods.

Don't make a practice of being late at work.

Don't do Government work in the company's time.

Don't keep one eye on the boss and another on your job; it's difficult to watch them both.

Don't take off your apron and look for a chance to wash up before quitting time.

Don't dig ditches in the grindstone.

Don't touch a broken band-saw until the machine has stopped running.

Don't leave the jointer with a heavy cut on; run the table up.

Don't make the final calipering of your work while the lathe is running.

Don't use double-ended turning tools, they are dangerous.

Don't forget that a tooth plane bit makes an excellent turning chisel for straight work.

Don't forget that dowel pins belong in the cope-half of pattern.

Don't fail to secure your work well in the lathe either between centres or in the face plate.

Don't stand directly in front of the rip saw, when sawing; they sometimes kick.

Don't provide bottom boards for core boxes unless necessary; they are often a waste of time and material.

Don't forget to make your core boxes scant in length and width, as cores, when drying, usually sag and swell.

Don't fail to make the necessary provisions for rapping and drawing the pattern.

Don't forget to allow ample material for finishing the casting.

Don't forget to consider how the casting is to be machined, and provide the necessary tool clearance.

Don't forget to put in tie pieces when required, to keep castings from spreading or cracking.

Don't fail to consult the moulder; his suggestions may be helpful, and we cannot do without him.

Don't forget that the moulder will always try to blame the pattern-maker for his own mistakes, if he possibly can, and—

Don't forget that the moulder is in a position to show you your shortsightedness, so—

Don't fail to consider the convenience of the moulder and core-maker at all times.

Don't think that your own time spent in the foundry is wasted; it may or may not be, it lies with yourself.

Don't be too important to do insignificant work.

Don't fail to have confidence in yourself, but—

Don't think you are a pattern-maker because you have been inside a pattern-shop.

Don't lose your head when anything goes wrong; other people have made mistakes.

PERSONAL.

THE late Sir David Radcliffe left estate valued at £64,699 gross.

MR. W. FOX, engineer, 5, Victoria Street, S.W., has taken Mr. F. W. La Trobe Bateman into partnership.

THE gross value of the estate of the late Mr. C. S. Allott, head of Messrs. Allott & Son, engineers, Manchester, is £5,144.

MR. W. W. DAVIDSON has been appointed manager of the engineering works of Messrs. Taylor, Smith & Company, Edinburgh.

THE late Mr. J. Gregson, of Messrs. Gregson & Monk, Vulcan Iron Foundry, Preston, and of Etherton Brothers' Foundry, left estate of the gross value of £78,292.

THE late Mr. J. Barbour, of Fairbairn, Lawson, Combe & Barbour, Limited, engineers, Leeds and Belfast, left estate of the value of £88,893.

THE gross value of the estate of the late Mr. R. T. Smith, of Messrs. W. H. Smith & Company, ironfounders, Whitchurch, Salop, is £19,664.

THE proposed permanent memorial to the late Sir Richard Tangye will take the form of a mural tablet with two medallions, to be erected in the local Art Gallery.

MR. A. C. KELLY, of the G.E.R. locomotive department, has been appointed traction engineer to the British Westinghouse Electric and Manufacturing Company, Limited.

MR. F. VEITHARDT has resigned his office of director in Veithardt & Hall, Limited, 41, Eastcheap, E.C., and Mr. F. Hamm has been appointed managing director in his stead.

MR. J. F. MACLAREN, of Robert Maclaren & Company, Limited, Eglington Foundry, Glasgow, has joined the board of James Dunlop & Company, Limited, Clyde Iron Works, Glasgow.

MR. C. E. WHITEHEAD, one of the managing directors of C. C. Dunkerley & Company, Limited, Manchester, has been the recipient of a presentation from the officials in recognition of his 50 years' connection with the firm.

THE gross value of the estate of the late Mr. J. S. Keep, chairman of the Horseley Company, Limited, and a director of the Midland Railway Carriage and Wagon Company, Limited, is £69,377. with net personalty £68,735.

NEW COMPANIES.

GRAISELEY FOUNDRY COMPANY, LIMITED.—Capital £3,000, in £1 shares.

HUTCHINGS' PATENTS, LIMITED.—Capital £52,000, to carry on the business of engineers, etc.

BICKERTONS ENGINE SYNDICATE, LIMITED.—Capital £10,000. Registered office: 54, New Broad Street, E.C.

SOWERBUTTS & WATSON, LIMITED.—Capital £5,000, to acquire the Union Iron Works, Cotton Street, Accrington.

WILLIAM MORGAN & COMPANY, LIMITED.—Capital £15,000, to acquire the existing business of crane builders and engineers.

ALFRED HERBERT (FRANCE).—Capital £5,000, to carry on in Europe the business of manufacturers of, and dealers in, machinery, etc.

STRONG & PAIGE TOOL COMPANY, LIMITED.—Capital £10,000, to acquire the existing business. Registered office: Stalker Lees Road, Sheffield.

W. TASKER & SONS, LIMITED.—Capital £30,000, to acquire the engineering business of Tasker & Sons. Registered office: Waterloo Iron Works, near Andover.

DRYSDALE & COMPANY, LIMITED.—Capital £50,000, to carry on the business of engineers. Registered office: 39, Kirkpatrick Street, Bridgeton, Glasgow.

THORNTON & CREBBIN, LIMITED.—Capital £15,000, to acquire the business of ironfounders, etc., of Thornton & Crebbin, Hammerton Street Works, Bradford.

FISK, DAVEY & COMPANY, LIMITED.—Capital £10,000, to take over the engineering business carried on at Tower Works, Tower Road, Aston, as Fisk, Davey & Company.

THOMAS BESSANT, LIMITED.—Capital £10,000, to take over from T. Bessant the business of a bedstead manufacturer, brassfounder, etc., at the Star Works, Hockley Street, Birmingham.

JAMES HOWARTH & COMPANY, LIMITED.—Capital £11,000, to take over the engineering business at the Victoria Works, Hall Lane, Farnworth, near Bolton, of James Howarth & Company.

BELHAVEN ENGINEERING AND MOTORS, LIMITED.—Capital £200,000, to acquire the business of Robert Morton & Sons, Limited, Belhaven Works and Allanton Foundry, Morningside, Wishaw. Registered office: 128, George Street, Edinburgh.

TRADE TALK.

Mr. C. Pullan, of Bradford, has established a branch at 19, Duke Street, Cardiff.

Turners & Manville, Limited, have removed to Hopetoun House, 5, Lloyd's Avenue, E.C.

Messrs. Drysdale & Company, engineers, of Glasgow, are building new works at Yoker.

The Adams Manufacturing Company have removed their London offices to 106, New Bond Street, W.

The first locomotive to be produced at the Clyde Works, near Sydney, N.S.W., has just satisfactorily passed its trial.

Messrs. W. E. Burnard & Company, electric power engineers, etc., have removed to their new works at Lowfields, Sheffield.

A receiving order has been made in connection with the affairs of the New Southgate Engineering Company, of Eastcheap, London, E.C.

The fourth engineering conference in connection with the Institution of Civil Engineers will be held at the Institution on June 19, 20, and 21.

It is rumoured that the Park Works, Gateshead, of Messrs. John Abbot & Company, are about to be thoroughly overhauled and reorganised.

Messrs. F. M. Russel & Company, 16, St. Helen's Place, London, E.C., have removed their head office to the Junction Works, Willesden, London, N.W.

Mr. H. Peaty, managing director of the New Conveyor Company, Limited, will in future represent the Company in Lancashire and Yorkshire, with offices at Manchester.

The Planet Foundry Company, Limited, of Guide Bridge, near Manchester have removed their London offices to 28, New Bridge Street, Ludgate Circus, E.C.

Messrs. Lorimer & Gillies, 70, Wellington Street, Glasgow, have been appointed agents for the Cannon Iron Foundries, Limited, Deepfields, near Bilston, Staffs.

Royce, Limited, of Trafford Park, Manchester, have appointed Mr. C. S. Mallet, 7, Queen's Gardens, Tetherdown, Muswell Hill, N., as their London and district representative.

An amalgamation has been arranged between the Metropolitan Amalgamated Railway Carriage and Wagon Company, Limited, and Docker Brothers, Limited, varnish manufacturers.

The Braintree Castings Company, of Braintree, Essex, have appointed Mr. J. Dickson, 3, Laurence Pountney Hill, Cannon Street, London, E.C., as their sole agent in London and district.

The Armorduct Manufacturing Company, Limited, have acquired 7 acres of land at Witton, Birmingham, where they propose to erect new works, in which the whole of their manufactures will be concentrated.

Palmer's Shipbuilding and Iron Company, Limited, of Jarrow, have acquired a large interest in the business of the new Griffin Engineering Company, of Bath, whose speciality is an oil engine for marine propulsion.

Andrew Barclay, Sons & Company, Limited, Caledonia Works, Kilmarnock, have been included in the Admiralty list of contractors for the supply and equipment of dock pumping machinery to His Majesty's Government.

Rumours have been circulated during the month that Hadfield's Steel Foundry, Limited, Sheffield, have been approached by Armstrong, Whitworth & Company, Limited, of Newcastle-on-Tyne, with a view to amalgamation.

The Vincit Company, Limited, of 117b, Queen Victoria Street, London, E.C., have been recently appointed sole British and Colonial agents of the Vienna Carborundum Works, manufacturers of carborundum and "Electrite," the latter being a new production of the electric furnace, for the production of grinding wheels.

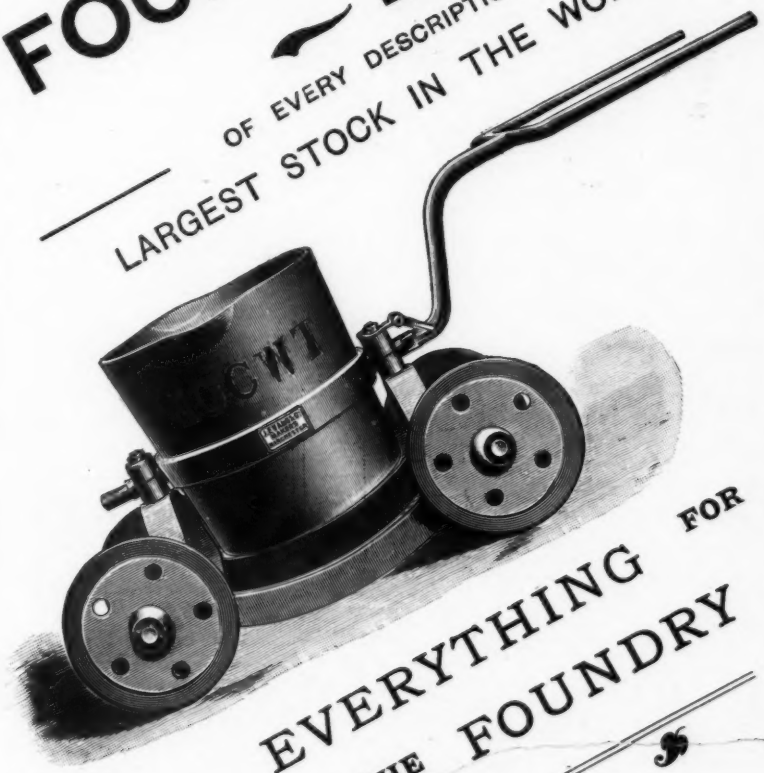
Mr. G. E. Byers has commenced business at Temple Bar House, Fleet Street, London, E.C., as a general merchant and agent, under the style of G. E. Byers & Company. Messrs. Byers have secured the sole representation in this country of the following Continental works:—Messrs. Concordiahütte, vorm. Gebr. Lossen Actiengesellschaft, Bendorf, a Rh., Engers, Germany, for wheels, axles, and tyres, steel and iron castings, etc.; Messrs. L. A. Wilczek, Paris, for special castings for motor cars. The Company have, in addition, been appointed export agents to Messrs. T. Davies & Son, West Gorton, Manchester, makers of foundry cupolas.

Contractors to H.M. Government.

FOUNDRY LADLES

OF EVERY DESCRIPTION.

LARGEST STOCK IN THE WORLD.



EVERYTHING FOR THE FOUNDRY

JAMES EVANS & CO.,

Telegrams:
"LADLES, MANCHESTER."
"BLACKINGS, GLASGOW."

BRITANNIA WORKS, MANCHESTER.

DEATHS.

MR. E. MASSEY, one of the managing directors of Goddard, Massey & Warner, Limited, Nottingham.

MR. P. CALDWELL, of Caldwells, Limited, engineers, of Warrington, in his seventy-fifth year.

MR. J. HOPKINSON, head of the firm of Joseph Hopkinson & Sons, Limited, valve makers, Huddersfield.

MR. R. BAILLIE, who until recently filled the office of secretary of the Carron Iron Works Company, aged 65 years.

MR. F. J. WHITE, manager of J. B. Past, Limited, agricultural engineers, etc., of Chelmsford, in his 56th year.

MR. P. WESTON, who was for many years works manager to the Coalbrookdale Company, Limited, at the age of 78 years.

MR. W. BROCK, the head of the firm of Messrs. Denny & Bros., shipbuilders, and Messrs. Denny & Company, engineers.

MR. G. R. COWEN, head of the firm of G. R. Cowen & Company, general engineers, of the Beck Works, Nottingham, in his 90th year.

SIR ALEXANDER WILSON, BART., formerly chairman and managing director of Cammell Laird & Company, Limited, in his 70th year.

MR. J. WENSLEY, head of the firm of Messrs. Wensley & Sons, agricultural engineers and implement makers, of Mark, near Highbridge, Somerset, in his 73rd year.

MR. GEORGE TURTON, founder of the firm of Messrs. George Turton, Platts & Company, manufacturers of buffers, coil springs, steel file hammers, etc., Sheffield, in his 69th year.

MR. J. BROADBENT, Oriel House, The Wallands, Lewes, at the age of 68 years. The deceased was the manager of the foundry department of the Phœnix Iron Works, in which capacity and that of foreman he was engaged during his 40 years' residence at Lewes.

MR. T. D. SWIFT, at his residence, 36, Ash Street, Southport. The deceased was the founder of the Ince Wagon and Iron Works, and despite advancing years his interest in the concern never diminished, and he continued to control its fortunes with unceasing care.

MR. MALCOLM COCKBURN, who founded the Gowanbank Iron Works and Springfield Foundry. The lattern concern he ultimately sold to the Davis Gas Stove Company, but up till the time of his death he continued to be connected with Gowanbank Iron Works. He was 79 years of age.

BRIGADIER-GENERAL EUGENE GRIFFIN, first vice-president and general sales manager of the General Electric Company, and also a director of the British Thomson-Houston Company, Limited, and the Compagnie Française pour l'Exploitation des Procédés Thomson-Houston, Paris.

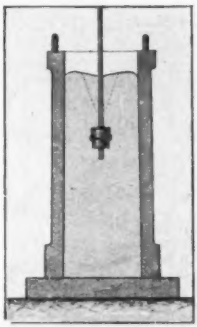
SIR BENJAMIN BAKER, the well-known civil engineer, at his residence, Bowden Green, Pangbourne, in his sixty-seventh year. The deceased gentleman, who was the son of Mr. Benjamin Baker, of Carlow, received his earliest training in a Welsh ironworks, from which he passed to the engineering offices of the late Sir John Fowler, afterwards being associated with him in more than one of the great undertakings which made them both famous. His name will always be associated with two great works—the Forth Bridge and the dam across the Nile at Assuan.

Ganister, Cupola Blocks, Fire Bricks,
Fire Clay.
Silica Bricks, Tuyeres, Stoppers, Nozzles, &c.
Steel Moulders' Composition, Silica Cement.

J. GRAYSON LOWOOD & Co., Ltd.,
DEEPCAR, nr. SHEFFIELD.
Telegrams: "LOWOOD, DEEPCAR."

Reducing Piping in Steel Ingots.

STEEL BLOCK SHOWING PIPING.



TIN OF "ANTI-PIPING" COMPOUND IN POSITION.

APPEARANCE OF BLOCK AFTER TREATMENT.

For Particulars apply to

THERMIT LTD.,

27, Martin's Lane, Cannon Street,

LONDON, E.C.

Telephone: 3749 Central.
Telegrams: "Fulmen, London."

ELDERS FOUNDRY COKE

As supplied to the British . . Admiralty Dockyards.

The following, selected from numerous letters, are eminent testimony as to the quality of our celebrated "A.A.A." Coppee Foundry Coke, carefully selected, and despatched in sheeted wagons.

From PECKETT & SONS, Bristol.

Bristol, October 25th, 1904.

We have been using your Selected Foundry Coke for some considerable time.

We have pleasure in stating that we are very pleased with it, as we find we get sounder and cleaner castings, more free from blow-holes and other defects, than we formerly did.

From MOUNTFORT PHILLIPS & Co., Llantrissant.

Llantrissant, October 25th, 1904.

In reference to the Foundry Coke you have been supplying us with for the last six months, we have very great pleasure in letting you know that it has given every satisfaction, and that our Works Manager and Workmen give it the highest praise.

Elders Navigation Collieries, LTD. Cardiff.

PRICES OF METALS.

The following table shows the approximate latest prices and position of stocks of metals during the past two years :—

Metals.	1903-7.	1905-6.
Iron—Scotch pig warrants ... ton	*(7/3)	*56/0
—Middlesbro' warrants ... ... ton	61/3½	49/6½
—W.C. M/nos Bessemer ... ... ton	81/0	67/6
—Stock, Scotch, May 30 ...tons	2,820	12,380
Copper—Chili bars, GMB ... ... ton	£99 12/6	£85 17/6
—Stock, Europe & afloat... ... tons	11,603	9,583
Tin—English ingots ton	£191 0/0	£186 0/0
—Straits ... ton	£190 5/0	£185 10/0
—Stock, Ldn. Hlnd and afft ... tons	12 580	13,242
Lead—English pig ton	£20 12/6	—
Spelter—Ord. Silesian ... ... ton	£25 0/0	—
Quicksilver-(75lb.) bottle	£6 16/0-£7	—
Antimony—Regulus ... ... ton	£75-£77	—

*Settlement price.

Castings.

In the Cleveland district the following are the nominal rates current for castings :—

	£ s. d.		£ s. d.
Columns (plain)	7 0 0	to	7 5 0
Pipes, 1½ to 2½ in.	5 10 0	to	5 15 0
,, 3 to 4 in.	5 2 6	to	5 10 0
,, 5 to 8 in.	5 0 0	to	5 2 6
,, 10 to 16 in....	5 0 0	to	5 2 6
,, 18 to 24 in....	5 0 0	to	5 2 6
Chairs	4 2 6	to	4 5 0
Floor plates (open sand)	3 12 6	to	3 15 0

Scrap.

The quotations for scrap, subject to market fluctuations, are as follows:—Heavy wrought (mixed), £2 17s. 6d.; light wrought, £1 12s. 6d.; heavy cast, £2 11s. 6d.; all per ton f.o.b., London. Copper (clean), £89; brass (clean), £63 10s.; lead (usual draft), £18 15s.; tea lead, £17; zinc, £20 10s.; all per ton delivered merchant's yard.

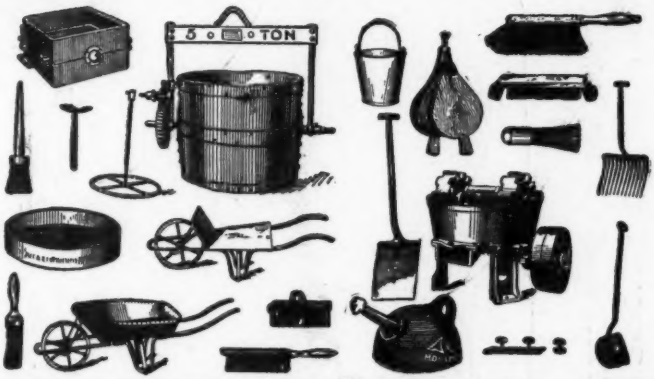
SILICA FIRE BRICK Co.,
OUGHTIBRIDGE.

GROUND GANISTER,
Wet or Dry.

Silco Cupola Bricks, 90 % Silica.
Better than Fire-clay Bricks for Cupolas.

Established 1863.

Jas. Durrans & Sons,



PHŒNIX WORKS, PENISTONE, Near Sheffield.

Manufacturers of all

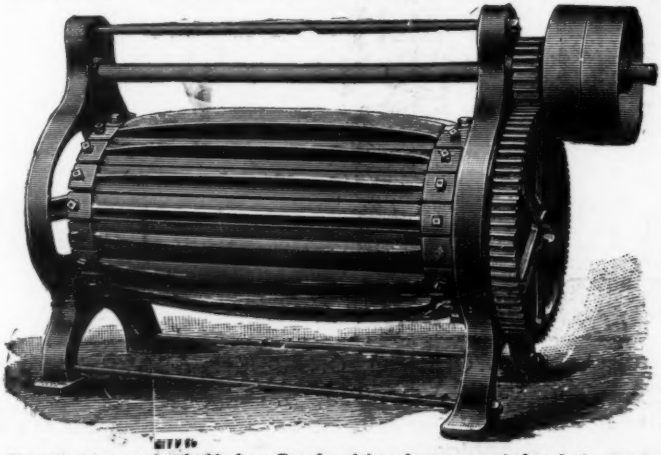
FOUNDRY EQUIPMENTS,

Composition Black Lead,

Plumbago, Core Gum, White Dust, and Coal Dust.

Ladles, Cupolas, Fire Bricks, Gannister, Stone Flux, Loam and Sand Mills, Casting Cleaners, Studs, Chaplets, Pipe Nails, Sprigs, Brushes, Wire Brushes, Core Ropes, Bellows, Buckets, Spades, Forks, Riddles, Sieves, Barrows, &c.

IMPROVED FOUNDRY RATTLER or FETTLING DRUM.



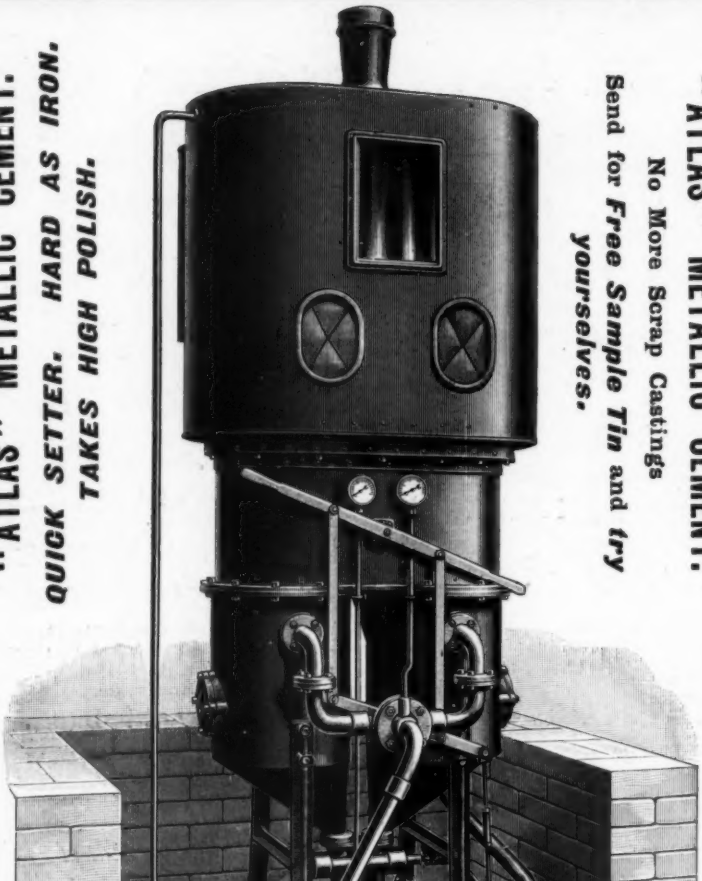
These Machines are invaluable for a Foundry, doing a larger amount of work of a superior quality, in a much shorter time than can be done by hand, without skilled labour.

"Dear Sirs,—We have been using your best Blacking for a large number of years, and always use it on our large Ingot Moulds, which, as you know, we have made up to 85 tons in weight.

"Yours faithfully, THE BRIGHTSIDE FOUNDRY & ENGINEERING CO., LD."

"ATLAS" METALLIC CEMENT.
QUICK SETTER. HARD AS IRON.
TAKES HIGH POLISH.

"ATLAS" METALLIC CEMENT.
No More Scrap Castings
Send for *Free Sample Tin* and *try yourselves.*



CONTINUOUS SAND BLAST APPARATUS

WITH WORKING CHAMBER ABOVE.

NO STOPPAGES to re-fill with sand.
NO CHOKING OF THE VALVES.
NO DUST Escaping into the Cleaning Department.

THE LONDON EMERY WORKS CO., Park, Tottenham, LONDON, N.

SITUATIONS VACANT.

WANTED, FOREMAN MOULDER, one accustomed to Machine Moulding in repetition work.—Address Box 439, Offices of THE FOUNDRY TRADE JOURNAL, 165, Strand, London, W.C.

MALLEABLE IRON and Steel Foundry seeks experienced FOREMAN, competent to produce castings in Malleable Iron and Steel Alloy from Cupola Furnace.—Apply Box 590, Offices of THE FOUNDRY TRADE JOURNAL, 165, Strand, London, W.C.

FOR SALE AND WANTED.

FOR SALE. "ROOT'S" PATENT BLOWERS.

No. 1a size, "Allday's," 6 in. outlet, £18.
No. 1 „ „ 7 in. „ £19.
No. 2 „ "Thwaites." 8 in. „ £20.

with Engines and Boilers to drive.
Address J. LIGHT, Wolverhampton.

ONE No. 3 Roots' Blower and Vertical Engine combined, outlet 8½ in.; makers, Thwaites.—T. WILLIAMS, Summerfield Place, Neath.

MOULDING MACHINES.—Two Farwell, as new, take 30 in. by 16 in., fitted stripping plate, Fine machines, £7 each. Evans' Turnover, take 24 in. by 18 in., as new, £12. Samuelson Machine, £4. Can be seen in London.—Address, Box 584, Offices of THE FOUNDRY TRADES JOURNAL, 165, Strand, London, W.C.

FOR PLANT & PRODUCTION of English Iron and Steelworks, see Ryland's Directory, the only work which gives complete lists of Iron and Steel-makers, with shapes and sizes of their rolled sections.—Publishers, EAGLAND & CO., LTD., 165, Strand, London, W.C. Price 25s. net.

EXCELLENT WORKS SITES, FOR SMELTING or Chemical Works. Exceptional facilities and privileges. Skilled labour.—Address, REES AND COMPANY, Consulting Engineers, 53, Victoria-street, Westminster, London, S.W.

IRON FOUNDRY, Rent Free (on lease), for 8 years, with option of purchase at low price in 5 years. Moulding Shops (78 ft. by 24 ft. and 15 ft. by 55 ft.), with Yard (78 ft. by 66 ft.), and detached Office, adjoining station few miles from Manchester, in busy neighbourhood. Owner another business requiring sole attention. Lease will be sold for £500; stock, fixtures, and fittings at valuation. Brass Furnaces for ½ ton, suitable for specialities or general trade. Principals only.—Apply Box 592, Offices of THE FOUNDRY TRADE JOURNAL, 165, Strand, London, W.C.

DOVETAILING MACHINE for box-making, 13 in. by 9 in., with 11 in. cutter, on iron stand, £5. Mortise machine, 5 in. stroke, 20 by 7 compound table, guard, vice, and tool, £4 Drilling machine, ¾ spindle, iron stand, £4. Roots' Blower, Thwaite's, 4 in. outlet, new, £7. Lathe, 4½ in centre, double-geared, 3 ft., compound slide, £5. Two Wood-turning Lathes, 4 ft. and 6 ft. bed, £4 each. Anvil Bellows, 30 in. face-plate, 4¾ hole.—FARRINGTON, Copenhagen Street, Newton Heath.

STIGNIC PAINT.
NEWEST AND BEST WASH FOR STEEL FOUNDERS.
PLASTIC CUPOLA GANISTER.
FINEST MATERIAL FOR LINING CUPOLAS AND FURNACES AND SETTING FIRE-CLAY BRICKS.
SPECIAL STEEL MOULDERS' COMPO.
STEPHENS & CO., Kidwelly.

FOUNDRY EQUIPMENT.
PATENT CORE MAKING MACHINES
No linseed oil or flour required.
NEW PORTABLE MOULD DRIERS
Moulds dried on the spot in an hour to one hour and a half.
J. W. & C. J. PHILLIPS,
23, COLLEGE HILL, London, E.C.,
And 7, PARK SQUARE, LEEDS.

FIRE BRICKS & CLAY
CUPOLA BRICKS.
BEST QUALITY.
Sole Lessees of Delph and Tintern Abbey Black and White Clay.
KING BROTHERS,
STOURBRIDGE.

In USE throughout the FOUNDRIES of the WORLD.

METALLIC CEMENTS

For ALL Purposes.

THOROUGHLY EFFICIENT AND RELIABLE.

PATENT EAGLE IRON CEMENT.
FUSIBLE CEMENT FOR CASTINGS.
FUSIBLE CEMENT FOR POLISHED SURFACES.
METAL CEMENT FOR FOUNDATION BOLTS.
IMPROVED DIAMOND CEMENT.
STEEL CEMENT
BRASS CEMENT
BRONZE CEMENT
} Specially prepared for use in Steel, Brass and Bronze Castings.

The whole of the above Cements are specially prepared to fulfil the requirements of Iron and Steel Founders, Brass, Bronze, etc., Casters, and have attained their present large sale solely in virtue of their superiority.

They will save you BOTH Time and Money, therefore AT ONCE Write, Telephone or Telegraph for prices and particulars to

J. W. BAINBRIDGE,

143, 145, 147, Rosebery Avenue, LONDON, E.C.

Telephone:
11230 Central.

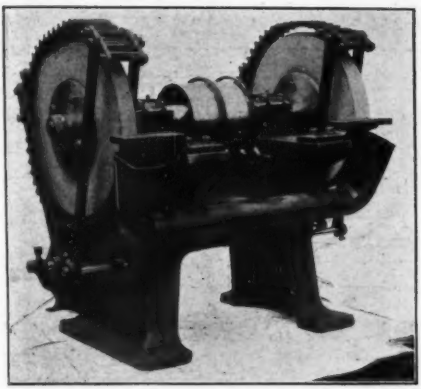
Telegrams and Cables:
"RUSSESCO, LONDON."

Telephone No. 47 Heaton Moor.

MANUFACTURERS OF

Telegraphic Address: "Heroic, Reddish."

Crystal Canadian Corundum,



CARBO CORUNDUM

AND

EMERY WHEELS,

For Foundry Use

ALSO

ALL CLASSES OF

GRINDING . . MACHINES. . .

Send for Catalogue and Prices.

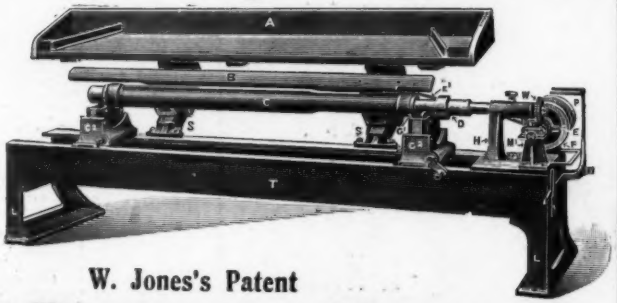
B. R. ROWLAND & CO., LTD.,

REDDISH, Near STOCKPORT.

A REVOLUTION IN

Pipe Foundry Practice

For Pipe Cores, 18 ft. long and 2 in. to 20 in. diameter.



W. Jones's Patent

CORE FORMING MACHINE

JONES & ATTWOOD,

STOURBRIDGE, ENGLAND.

A

PNEUMATIC PLANT

OF ALL KINDS AND FOR ALL PURPOSES.

Air Compressors, Vacuum Pumps, Receivers, Chipping, Rivetting & Caulking Hammers, Drilling Machines, Grinders, Forges, Hoists, Spraying Machines, Painting Machines, Sand Blasting Machines, Sand Shifters, Air Lift Water Pumps, Hose, Fittings, etc.,

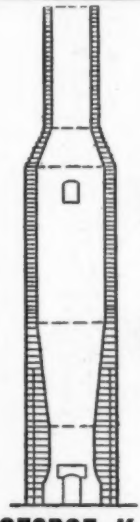
OF BEST BRITISH MANUFACTURE.

LACY-HULBERT & CO., Ld.,

. . . **Pneumatic Engineers,** . . .

91, VICTORIA STREET, LONDON, S.W., and

BOREAS WORKS, BEDDINGTON, Surrey.



Special . .

Quality . .

FIREBRICKS

. for .

CUPOLA

LININGS.

GEORGE K. HARRISON, Ltd.

Fireclay Brick Works,

STOURBRIDGE.

38¼"
McNEIL'S
PATENT UNBREAKABLE
STEEL LADLES
These Ladles are manufactured by a patented process, each from a single steel plate without weld or rivet. They are extremely light, being at the same time the strongest and most durable in the market. Ladles to contain 56 lb. of metal only weigh about 7 lb. each. They are made of all capacities from 30 lb. to 60 cwt., with or without lips; also mounted or unmounted. They are also suitable for chemical and metallurgical processes. List of sections and prices on application t
CHAS. McNEIL.
KINNING PARK IRONWORKS,
GLASGOW.
32¼"

Can also be made in Aluminium.

Agents for London district:—The Simplex Coke Oven and

Telegrams—
"Tuyere, Manchester."

ON ADMIRALTY LIST.

National Telephone—
No. 70, Openshaw.

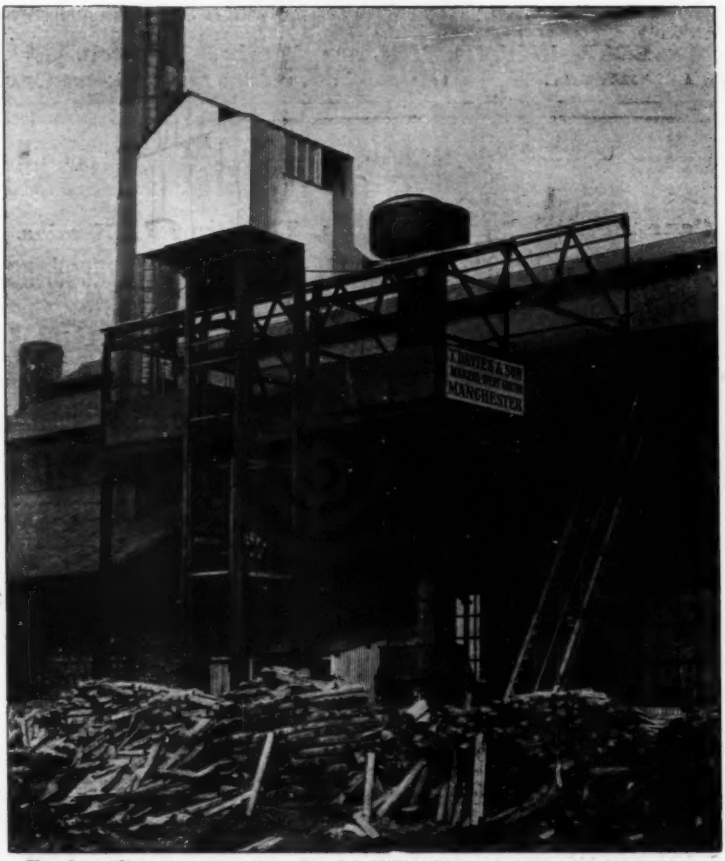
T. DAVIES & SON,

Railway Ironworks,

WEST GORTON, MANCHESTER.

ESTABLISHED 1876.

Agents for London district:—The Simplex Coke Oven and Engineering Co., Ltd., Temple Bar House, London, E.C.



Agents for Scotland:—The Simplex Coke Oven and Engineering Co., Ltd., 144, St. Vincent St., Glasgow.

The above illustration represents a Complete Melting Plant, consisting of Rapid Cupola to melt 5 tons per hour, Charging Platform with a storage capacity of 150 tons, Electrically driven Blower and Hoist.

Speciality:— FOUNDRY CUPOLAS OF ALL TYPES,

UPWARDS OF 500 MADE AND SOLD,

CHARGING PLATFORMS.

COMPLETE MELTING PLANTS SUPPLIED.

FIRST CLASS PATTERN PLATES

are now being made by moulders in foundries, with

WHITE'S PATTERN PLATE APPARATUS

without the aid of any expensive machine tools.

No method of making repetition work in foundries **is complete without** a simple ready system of making pattern plates as required for either hand or machine moulding.

White's system completely meets these requirements. Write for illustrated pamphlet, to

EDW. WHITE, Windsor Works, Redditch.

ON ADMIRALTY LIST. London Office: W. Littleton, 9, Fe church Street, E.C.

GROUND GANNISTER, STEEL MOULDERS' COMPOSITIONS, SILICA CEMENT.

Gannister Bricks, Fire Bricks, Stoppers and Nozzles.

Sole Makers of **"PEHRSON'S PATENT STEEL MOULDERS' GREENSAND."**

Crucible Clay for All Purposes.

J. & J. DYSON, Sheffield Gannister Works, ATTERCLIFFE ROAD, **SHEFFIELD.**

Telegrams—"Dyson's, Stannington." Telephone—No. 702 Sheffield.

CHAS. HALL,

Foundry Requisite Maker,

DANTZIC ST., MANCHESTER.

STEEL WIRE BRUSHES.

Chaplets and Studs a Speciality.

COLD BLAST PIG-IRON.

M. & W. GRAZEBROOK,
DUDLEY.

STOURBRIDGE FIRE BRICKS

OF BEST QUALITY FOR LINING CUPOLAS

— IN STOCK, ALSO MADE TO ANY DESIGN. —

Linings Stocked to Customers' Plans to ensure IMMEDIATE DELIVERY.
All kinds of Fireclay Goods of highest quality.

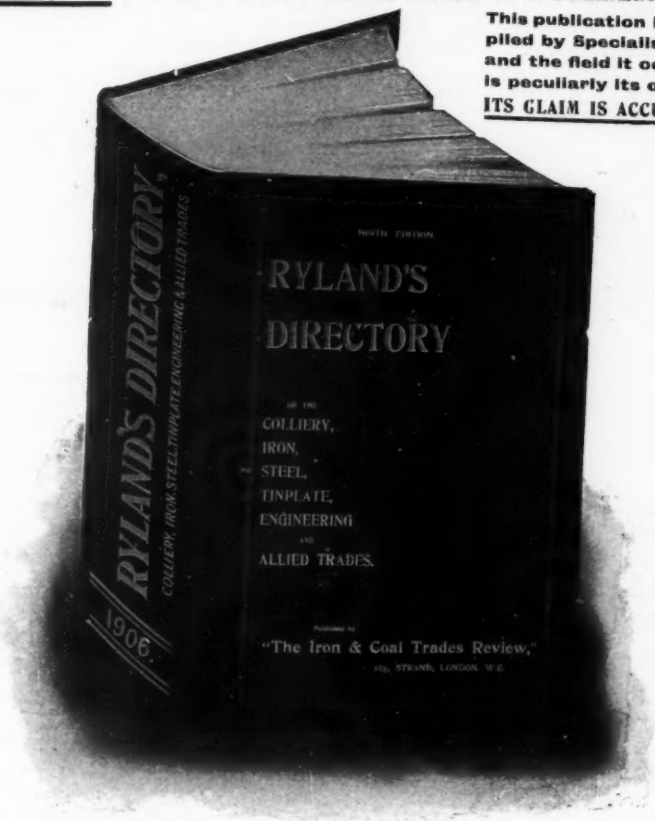
HARRIS & PEARSON, STOURBRIDGE.

Telegrams: "Fireclay, Stourbridge." Telephone: No. 7 Brierley Hill.

LISTS!

HAVE YOU A GOOD LIST OF FOUNDRIES, IRON, STEEL, ENGINEERING WORKS AND COLLIERIES?

This publication is compiled by Specialists, and the field it occupies is peculiarly its own. ITS CLAIM IS ACCURACY.



RYLAND'S DIRECTORY has been the recognised authority for a quarter of a century in the trades to which it appeals.

Its staff is largely composed of Engineers who have either served their time in the shops, or are technically educated. This expert sifting means a great monetary saving to those requiring a directory.

If you are desirous of pushing your business in the Colliery, Iron, Steel, Tinplate and Engineering Trades, either as Producer, Manufacturer, Merchant, Agent, Traveller, etc., it would prove most valuable to you.

NINTH EDITION, 1906, NOW READY.

Price (Prepaid) 25/- Nett.
CLOTH BOUND.

CUT THIS OUT.

SUBSCRIPTION ORDER FORM.

Enclosed please find.....value 25/- for the 1906 issue of Ryland's Directory.

Name.....

Address .....

.....

CUT THIS OUT.

Publishing Offices: **EAGLAND & Co., Ltd., 165, STRAND, London, W.C.**

FOUNDRY REQUISITES.

BRUSHES, BELLOWS, BUCKETS, BARROWS, BLACKING, COAL DUST.

CHAPLETS & STUDS, CEMENT, CORE GUM, CORE ROPE, CORE TAPER, CRUCIBLES, CUPOLAS.

LADLES, RIDDLES & SIEVES, SPADES, SPRIGS, TERRA FLAKE, FERRO-ALUMINIUM, ETC.

MOOR & SONS, 1, Fennel St., MANCHESTER, (Dept. F.)

Established 1857. Telegrams "Acklam." Telephone, No. 3566.

CUPOLA LININGS.

HIGH-CLASS QUALITY

FIRE BRICKS

Made from specially selected clays.

BEST CRUCIBLE CLAYS.

Blast Furnace, Hot Air Stove, Boiler Seating, Flue Cover, and other Best Fire Bricks.

JOHN HALL & CO.,

Of Stourbridge, Ltd.,

STOURBRIDGE.

Patterns — *and* — *Core Boxes*

FRED HIRST,

Phœnix Pattern Works,

HUDDERSFIELD.

ELASTENE CORING ROPES

Are superior to Hay or Straw Bands and are now extensively used in . .

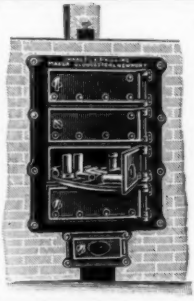
ALL LEADING FOUNDRIES.

Sole Makers—

CITY of LONDON WOOD-WOOL Co.,

Contractors to H.M. Government,

Plover Street, London, N.E.



Charles D. PHILLIPS'

Registered and Improved No 356,812

FOUNDRY CORE OVEN

built in wall.

Head Office—

Emlyn Works, Newport, Mon.,

(and Gloucester).

Established 39 years.

ON ADMIRALTY, WAR OFFICE, AND INDIA OFFICE LISTS.

SPECIAL BLACKINGS FOR HEAVY ENGINEERING CASTINGS.

BLACKINGS

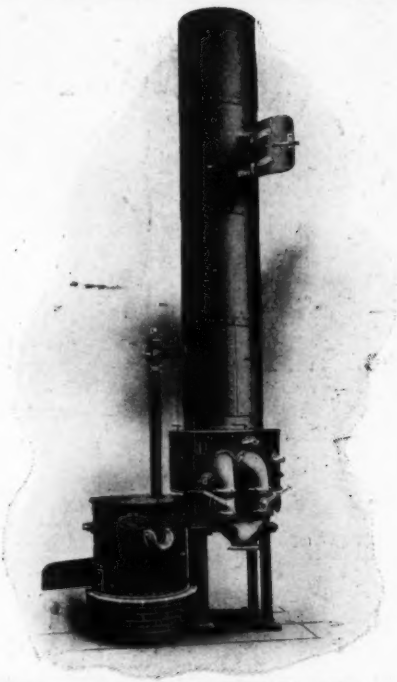
(Iron Moulders).

CARLTON BLACKING FOR STOVE WORK BATHS, etc.

STRAW ROPES and other Foundry Requisites.

THOMAS WILKINSON & CO., LTD., MIDDLESBROUGH.

FOUNDRY PLANT.



Cupolas,
with or without receivers or drop bottoms.

Roots' Blowers,
belt, steam-engine, or electro-motor driven.

Charging Platforms, Hoists, and Ladles.

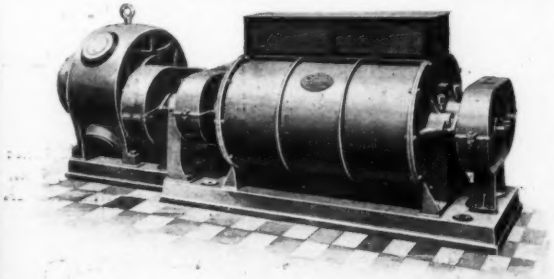
ECONOMICAL RESULTS GUARANTEED.

We are also Manufacturers of Steam Hammers, Smiths' Hearths, Centrifugal Pumps and Fans, High-Speed Engines, and the "Bradford" Patent Boiler Feed Pump.

CONTRACTORS TO HIS MAJESTY'S GOVERNMENT.

THWAITES BROS., LTD.,

Vulcan Ironworks, BRADFORD.



Telegrams —
"THWAITES, BRADFORD."

Telephone:—
No. 325 BRADFORD.

London Office—
96 & 98, Leadenhall Street, E.C.

CATALOGUES ON APPLICATION.

Evans' Rapid Cupolas.

ON ADMIRALTY LIST.

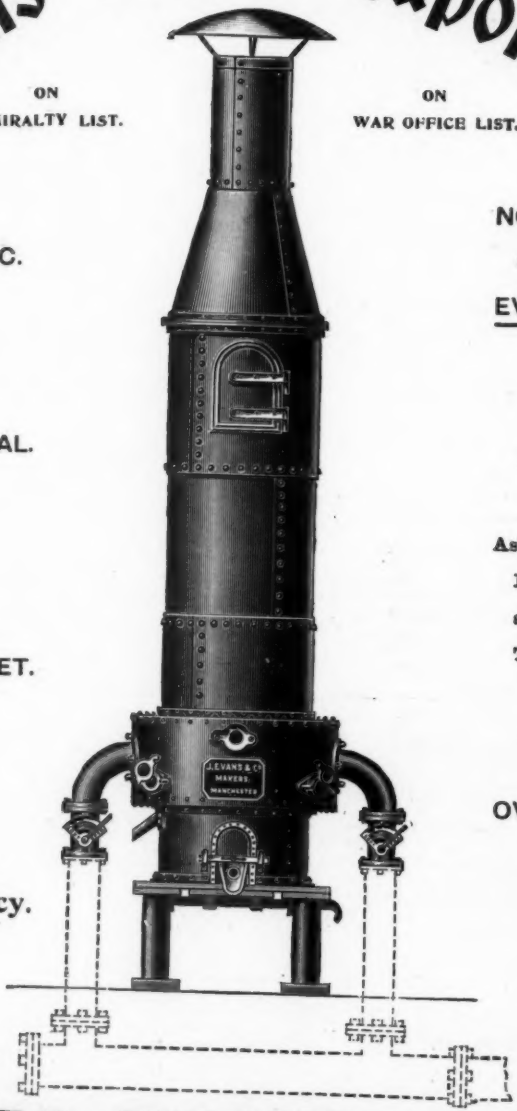
ON WAR OFFICE LIST.

MOST SCIENTIFIC.

MOST ECONOMICAL.

BEST IN THE MARKET.

Highest melting efficiency.



NONE SO GOOD AS EVANS' RAPID.

Ask for Estimates and Copy Testimonials.

OVER 400 IN USE.

Telegrams: "LADLES, MANCHESTER."

Telephone: 2297 Nat., Manchester.

JAMES EVANS & CO.,

Britannia Works, Manchester.